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State of Pennsylvania,

FOR THE

PROMOTION OF THE MECHANIC ARTS.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE, CIVIL ENGINEERING, THE ARTS
AND MANUFACTURES, AND THE RECORDING OF AMERICAN
AND OTHER PATENTED INVENTIONS.

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JOURNAL

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OF THE STATE OF PENNSYLVANIA,

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JANUARY, 1848.

CIVIL ENGINEERING.

Twenty-first Annual Report of the President and Directors to the Stockholders of the Baltimore and Ohio Railroad Company.

At a meeting of the stockholders, held pursuant to the charter, on the second Monday of October, 1847, in the city of Baltimore, the President and Directors of the Baltimore and Ohio Railroad Company submitted the following report and statement of the affairs of the Company:—

First.—*Of the Main Stem.*

The statement A shows the state of the Company's affairs on the 30th ult., and the revenue and expenses of the *main stem* for the year ending on the same day are shown by the statement B.

These statements exhibit a considerable increase both in the trade and travel; and it will appear, from an examination of the various items of which they are composed, and from the elaborate report of the chief engineer, acting as general superintendent, hereto appended, that in proportion to the amount of business, there has been a very favorable diminution in the cost of transportation and expense of working. The general economy in the management of the road, either in regard to its particular condition, or as compared with other roads in the United States, or elsewhere, though more favorably situated, is also worthy a particular notice, and ought not to escape the attention of the stockholders.

The gross receipts from the business of the *main stem*, independent of its connexion with the Washington road, amount to the sum of $1,101,936·58, and the expenses of working and management, of all kinds, to the sum of $590,828·98, little more than 50 per cent. of the gross receipts, and leaving a balance of net earnings, over all expenses of working, of $511,107·60, being more than seven and one quarter per cent. upon the capital. Without reference to the detailed statements and observations in the report of the chief engineer, and to the subsequent remarks in this report, or to the working of other similar roads, this result would establish the general economy in the administration of this work, and show that the cost and expenses of transportation bear a reasonable and economical proportion to the entire receipts from the trade and travel. If, therefore, there were no other objects to which the Board were under an obligation to apply the above stated net receipts, the dividend for the present year, under the present system of management, might not have been less than seven per cent., and the necessity of applying them to other objects, however it might be regretted, has been altogether unavoidable.

The stockholders were informed in the last annual report, that engagements made prior to the month of September, 1846, for reconstruction of thirty miles of the old track. for new locomotive engines, for new burthen cars, and for improvements at the several depots, stated in that report at $325,000, would be chargeable upon the receipts of the year just closed; and that by the interest upon the bonds then authorized to be issued, and the instalment payable during the year to Messrs. Baring, Brothers & Co., the amount so chargeable would be swelled to an aggregate of not less than $418,000.

It is now to be observed that the payments during the year on account of all the foregoing items, have actually amounted to the sum of $403,662·63, and that from the receipts of the year there has also been paid, on account of surveys west of Harper's Ferry, for interest on temporary loans, rendered necessary to meet the engagements of the previous year in anticipation of the accruing revenue, and for additional burthen cars, indispensable to comply with the more pressing demands of the increasing trade, the further sum of $37,534·10.

Of the net earnings, as shown above, not expended on account of capital, and which it is in the power of the Board to replace by the sale of their six per cent. bonds, the Board have declared a dividend of three dollars upon each share, and applied the further sum of $20,000 to the sinking fund—provided, as stated in former reports, for the reimbursement of the loan of $1,000,000 on account of the Washington road, leaving a surplus to be reimbursed from the cost of reconstruction by the sale of bonds, of $23,916·50.

It ought also to be observed that while, from the causes already explained, the dividend to the city and individual stockholders does not exceed three dollars per share, the State of Maryland has derived much greater advantages from her connexion with this enterprise. The subscription of $3,000,000 made by the State, in 1836, with the distinct understanding that both the city and State should at the time contribute an equal sum, was paid in five per cent. sterling bonds; and that, although the subscription by the city has been fully realized and applied to the construction of the road to Cumberland, yet, that in consequence of the depreciated credit of the State, the sterling bonds received from the Treasurer have remained for the most part unavailable. Of the entire sum of the $3,000,000, an amount not exceeding 5000 pounds sterling has been disposed of, and while the Company has continued regularly to pay the interest upon that amount to the bondholder, the State, during the whole period, has annually received larger sums from the Company than any other stockholder.

During the past year, including the bonus, the State has received from the earnings of the Washington road, an amount equal to ten per cent. upon her subscription to that road—and with the dividend from the earnings of the main stem, has actually received a sum equal to seven per cent. upon her investment in both roads.

Of the revenue heretofore applied to reconstruction, the Board have replaced, during the year, the sum of $49,105·12 by the sale of their six per cent. bonds, at prices averaging about their par value: and it may be added, that, by the consent of the city authorities to receive the present dividend, payable to the city in the same securities, the Board will be enabled to make a further sale of the same description of bonds to the amount of $105,000, at their par value.

It is proper also to state, that during the past year the Board have entered into contracts, within the estimates of the engineer, for the further reconstruction of 31 miles of the old track, payable partly in the Company's notes at long credits, and partly in the six per cent. bonds alluded to in the last annual report, at par; and that they have also entered into contracts in the further amount of $152,872, being about $46,000 less than the cost estimated by the chief engineer, for indispensable alterations in certain parts of the old track, payable altogether in similar six per cent. bonds of the Company at their par value. For so much of the foregoing engagements as are payable in the notes of the Company, the Board must look to the sale of their six per cent. bonds, or to loans in another form; and, until one of these can be effected upon favorable terms, the current receipts must be used. The effect, therefore, upon the dividend of the current year must depend upon the success of one of the first resources.

A proper regard to the increasing trade and travel upon the road, and to its economical working, and, what is of even greater importance, to the safety of the public, would not permit a thorough reconstruction of the old and imperfect track to be longer delayed. By some, or all of the resources at the command of the Board, these objects must be accomplished with the utmost possible despatch; and the duty of the Board will only be discharged by accomplishing them according to their best judgment, with all the means at their command, and in a manner the least onerous to the stockholders.

Up to this time, it is not doubted, that an impartial examination of the subject will satisfy the stockholders, that in the discharge of the arduous and multifarious duties devolved upon the Directors, the Board have practised a due economy and carefully guarded the interests entrusted to them.

The exhibition they are now enabled to make of a net earning of more than seven and one quarter per cent. upon the capital, over and above all the current expenses of working and management, including extraordinary repairs of the road way, bridges, and machinery of all kinds, is not only a conclusive evidence of the economy with which their duty has been performed, but ought to afford substantial evidence of the future profits of the work, and of the stability of the Company's credit. This part of the subject, however, cannot be properly understood or appreciated, nor will the stockholders be able to do justice to the present condition or future prospects of their own enterprise, nor properly sustain its credit, without bearing in mind that their work is, and for some time must remain, in an unfinished state—unfinished, not so much in regard to the termination to which it is designed ultimately to extend it, but, what is equally important, and to this occasion more pertinent, unfinished in regard to its capacity and power of operation throughout the present line. It would be a grave error, leading to serious and perpetual misapprehension, to conclude that a railroad, actually constructed between two given termini, was thereby finished and requiring no farther expenditure from the application of its resources to the purposes of capital. A railroad can be said, in no sense, to be finished until it is not only constructed and open for trade between two given points—the road must be considered as unfinished until it can be supplied with all the power and machinery of every description necessary to accommodate the public, and effectively and economically to conduct its daily operations. In all railroad companies in all countries, this obvious view of the subject is universally conceded and acted upon, and everywhere the cost of a road, and of all other objects comprehending its capital, is understood to include, not only the actual construction of the road way, but the supply of all the stations, depot buildings, engines, cars, and machinery of all kinds necessary to its effective operation. Until, therefore, a railroad is not only actually constructed, but provided with all that is necessary for its effective working, it must remain unfinished; and, while it is the duty of the company to proceed to finish the work in their charge with all proper energy, the only means by which it can attain that object, is an increase of its capital by new subscriptions, or by some form of loan, for the reimbursement of which, both principal and interest, the annual receipts are the only resource. The stockholders will scarcely need to be informed, that not only the present road from Baltimore to Harper's Ferry, in consequence of the radical imperfection and defectiveness of the original construction, is yet unfinished, requiring a large annual expenditure to complete it; but that in regard to the necessary stations, depot buildings, and cars, and machinery of every description, the whole work is yet unfinished, and on this account annually absorbing a considerable portion of the receipts to supply the defects. It must, then, be apparent that any unfavorable disproportion between the rate of the dividends and the amount of the net earnings, can in no degree be attributable to improper expenditure in the working, but arises wholly from an unavoidable necessity of applying so large a proportion of the receipts to put the road in a finished state, to adapt it to the just demands of the trade, and to render it ultimately profitable to the stockholders. It is seen that during the past year, under the present economy, if the defectiveness of the road and inadequacy of the machinery had not required such a heavy expenditure, the net earnings of the year would have justified a dividend to the stockholders of seven and a quarter per cent.; and yet, that in consequence of the necessity of such an expenditure, the Board have been compelled to confine the dividend to three per cent., and temporarily to apply at least four per cent. of the net earnings towards completing the work.

It may not be out of place, in this connexion, and for better illustration of this part of the subject, to state, that from the opening of the road to the year 1837, inclusive, (a period of eight years,) the gross receipts amounted to $1,439,151, the *expenses* to $1,038,818, the dividends to $144,138, and the expenditure, on account of capital only, to $247,195. From the close of the year 1837 to the end of 1847, the gross receipts have been $5,979,097, the expenses $3,332,783, the dividends, $735,000, and the expenditure on account of capital $1,911,314. So that, from the opening of the road to the present time, the stockholders have received of its earnings $879,138, and the expenditure for general objects of capital has been $2,158,509. The ratio of expenses to receipts prior to 1837 was 72$\frac{7}{10}$ per cent., and from 1837 to 1847, the ratio has been 55$\frac{7}{10}$, while the excess of current receipts over current expenditure, prior to 1837, was $391,333, and subsequent to 1837 it has been $2,158,509.

In yielding to the necessity which has thus been explained, the Board have only followed the example of all others engaged in the management of similar works, practising, as they believe, not less economy than any other administration of railways that they might be required to imitate; and while it may be expected of the public at large to be satisfied with so liberal a provision for the accommodation of the business, the stockholders, in view of the ultimate benefits to flow from it, will, it may be hoped, be content with a policy dictated no less by the necessity of the case, than their own duty and true interest.

The result of this policy, and the economy with which it has been carried out, as well as the beneficial effects upon the interest of the stockholders, may be seen in the progressive improvements in their own enterprise, and in its present condition and future advantages.

The influence of the administration of the present Board cannot be traced to an earlier period than the middle or close of the year 1837. In that year, the length of the road being 82 miles, only 157,102 passengers, and 66,703 tons were carried in the cars, and the machinery imperfectly adapted to that amount of business: in the present year, upon a road of 178 miles, there have been transported 288,674 passengers, and 263,334 tons; and, unless from sudden accumulation at unexpected and temporary periods, there has been no deficiency of power or means. Anterior to the year 1837, and up to the year 1835, there had been only five small dividends, varying from 37½ cents to $1·12½ per share, and from 1835 to 1840, no dividend had been declared.

In 1837, the outstanding current obligations of the Company were not less than $130,000, and the aggregate expenses of working the road only, was at least ninety-five cents in the dollar! As might have been expected from this result, the power and machinery of the Company were inadequate even to the inconsiderable business of that period; and only seven hundred and fifty thousand dollars of the original subscription remained unpaid, which, in a few years only, must have been needed for the payment of debts, and for the augmentation of machinery, leaving other objects of expense swelling beyond any resources at the command of the Company. How long, under a continuance of such causes, the road could have been kept in operation, it would now be needless to conjecture. At the end of the year 1840, a period of two years, the remaining capital had been called in, punctually paid, and applied to the reduction of the inclined planes at Parr's ridge, to the removal of other sources of perpetual and wasting expense, and to the augmentation of machinery of all kinds. During the same time, an improved system of repairs of roadway and machinery was adopted—the outstanding obligations of the Company were fully discharged, and a dividend of $2 per share was paid to the stockholders out of the net earnings. During those two years, the construction of the road west of Harper's Ferry was commenced, under circumstances in many respects unpropitious, and as early as the month of November, 1842, from the proceeds of the city subscription of $3,000,000, and the application of a considerable portion of the annual receipts, was completed as far as Cumberland, a distance of 96 miles, at a cost not less than $3,623,606·28.

During the period subsequent to 1840, a dividend to the stockholders was intermitted for a single year only, the earnings of the year 1842 having been applied to the extension of the road from Harper's Ferry to Cumberland. In 1841 and 1843, the dividend was $2 per share; in 1844, $2·50 per share; and in 1845 and 1846, $3 per share.

The comparative progressive improvement in other respects, during the same period, subsequent to 1837, is not less striking. In that year, the Company owned only fourteen locomotive engines, and these of the fourth, or smallest class, of which some were actually unfit for use, and the whole, more or less, in an imperfect condition. From that time to the present, the motive power of the Company has been increased, by purchase or otherwise, of thirteen of the largest class, two of the second, twelve of the third, and eleven of the fourth class, in all thirty-eight, and in actual capacity equal to seventy-two of the class of those employed in 1837. The augmentation and improvement in the number and condition of the cars and other machinery may be taken to be in the same proportion.

In 1837, the cost of repairs of road and bridges, the latter being comparatively few in number, was not less than at the rate of $1203 per mile of road, and at the end of 1846, before the occurrence of the adventitious and temporary causes adverted to and explained in the report of the chief engineer hereto appended, notwithstanding an increase of nearly three-fold in the business of the road, and a considerable addition to the number of timber bridges, the cost of similar repairs did not exceed $918 per mile of road, being about twenty-five per cent. less than at the former period. The cost of repairs of machinery, engines, and cars, in 1837, was at the rate of $29\frac{3}{10}$ cents per mile run by the locomotives with trains, and in 1846, the cost did not exceed $16\frac{1}{10}$ per mile run; being little more than one-half of the former cost, although the trains hauled in the last year were, in all instances, considerably larger. In 1837, the aggregate expenses of working the road, exclusive of the expense of horse power in the streets of Baltimore, and over the old inclined planes at Parr's ridge, was at the rate of not less than 173 cents per mile run by the locomotives; and in 1846, the same expenses did not exceed the rate of $59\frac{8}{10}$ per mile—nearly two-thirds less than in the former period.

It has been already stated, that the proportion of the expenses of working the road to the gross receipts in 1837, was as much as 95 per cent; and it may now be added, that in 1846, the same expenses did not exceed 52 per cent. of the gross receipts. It must be observed, moreover, that this great reduction has been effected under the influence of a vastly augmented trade, of a continued dilapidation of the old and imperfect track, of a considerable multiplication of timber bridges, and of a reduction in the charges for transportation of more than 35 per cent. below the rates in 1837.

Excepting in Great Britain, where the rates of charges are high, and the wages of labor low, and where the receipts from passengers, always the chief source of profit upon railways, are much greater in proportion to those from burthen transportation, the expenses of working railways rarely, if ever, fall short of 50 per cent. of the gross receipts, and in most parts of the continent of Europe, and elsewhere, they more frequently exceed that ratio. It is to be observed, moreover, that this proportion is seldom or never maintained, except in the instances of new and well constructed railways with the most improved rail and form of structure, and with the aid of other advantages indispensable to the cheap management of such works, and where the receipts from profitable passenger traffic considerably exceed those from the transportation of burthen. Independently of the railways in England, the ratio of expenses to the gross receipts, and the economy in the working of the Baltimore and Ohio railroad, will be found to compare most advantageously with all the European works, the former being less and the working cheaper than upon the European works.

The roads in New England possess most of the advantages of newness and strength of construction, of liberal charges and large trade, and from the density of a general and manufacturing population, derive larger receipts from passenger traffic than from tonnage; and are also universally conceded to be conducted with commendable regularity and economy. They possess besides many material advantages peculiar to that part of the Union, which would enable them to attain a superiority over even the skill and economy of European works, which it would be difficult successfully to imitate.

With all these advantages, an investigation into the comparative cost and expenses of working the Baltimore and Ohio railroad, and of the principal New England roads, according to information derived from authentic sources, would still further illustrate the economy with which the operations of this road have been conducted.

The average cost per mile of twelve of the principal railroads of New England, including their necessary equipment, may be stated at $46,000, and that of the Baltimore and Ohio railroad, including the thirty miles reconstructed during the past and preceding years, may be taken to be about the same. If the cost of reconstructing the remaining portion of the old track, and of the alterations now in progress, be added, the average cost of the road would be more than $50,000 per mile. The average of all the expenses upon eleven of the principal New England roads per mile run by the locomotives with trains, during the year 1846, was not less than $78\frac{1}{10}$ cents; and that upon the Baltimore and Ohio railroad, during the same period, exclusive of the cost of horse power in the streets of the city, was, as before stated, not more than $59\frac{8}{10}$ cents; showing a difference of nearly twenty-five cents in favor of this road.

The average of the proportion of expenses to the gross receipts upon the eleven New England roads, during the year 1846, was a fraction over fifty per cent., and that of the Baltimore and Ohio railroad, during the same period, may be stated at not more than fifty-two per cent. If, in regard to this part of the comparison, the superior construction and comparative newness of the New England roads, their exemption from the employment of horse power in cities, and the greater amount of passenger traffic in proportion to that of burthen, be taken into consideration, (that on the Baltimore and Ohio railroad being $654,916·14 from tonnage, and only $447,020·14 from passengers,) the cheapness of working this road would be apparent. Of all these facts and grounds of comparison, therefore, it may be safely predicated, that, as soon as the old track of the Baltimore and Ohio railroad shall be thoroughly reconstructed, and, by an adequate provision of motive power and other machinery, and of depot buildings, necessary for its general purposes, the entire road shall be placed in a finished state, the general expenses will not exceed the best economy upon any other work.

Notwithstanding, however, the confidence of the Board in the results already adverted to, and in the general system of management gradually adopted subsequent to the year 1837, they have not been insensible to the necessity of adapting it, from time to time, more perfectly to an extended road, to a rapidly increasing trade, and to the great augmentation of power and machinery demanded by the increasing business. The accumulated business, in the year 1846, and the near approach of the periodical renewal of the timber of the road over its entire line, presented an appropriate occasion to revise the general system of management, and in the month of November last, the President suggested a scheme of a modified system, and invited the attention of the Board to the necessity of a particular examination into the present organization of the Company, and to the introduction of some reforms which he thought might be advantageously made. He also asked the appointment of a committee by whom he might be assisted in the investigation, and in maturing the reforms that might be deemed expedient. The principal objects to be attained, by the proposed modifications, consisted in confining the general supervision and superintendence of all the departments nearer to their duties, and, by a judicious subdivision of labor, to insure a proper adaptation and daily application of the supervisory power to the objects under its immediate charge; in the multiplication of checks, and to effecting a strict responsibility in the collection and disbursement of money; in confining the Company's mechanical operations in their shops to the purposes of repairs, rather than of construction; in promoting the economical purchase and application of materials and other articles needed in every class of the service; and in effecting a strict and more perfect responsibility in the accounting department generally.

After diligent investigation, with the aid of the experience of other roads in New England, and elsewhere, the committee proposed to attain the foregoing objects by confiding the departments of transportation, of the construction and repairs of the road, and of the repairs of machinery, to a separate superintendence; each being subject to the immediate supervision of a professional engineer, under the direction of the President.

They subjected all these officers, and all other principal agents, to an annual appointment, and required satisfactory security for the faithful performance of his duties from each. They also adopted measures for the purpose of confining the receipt of money to as few agents as possible, and for insuring the prompt payment from all of monies received by them; and they prescribed a new and securely guarded system of tickets, recommended by the best experience in other companies; and imposed further checks upon conductors, and other agents, which were thought would prove effective in enforcing a rigid accountability from all. They revised and remodeled the system of accounts, and, by bringing them into the Company's office, effected a daily accountability and settlement of the account of each of the agents by the Treasurer and Secretary, under the immediate supervision of the President.

It is not proposed in this place, to do more than indicate the general features of the modified system now adverted to. It was adopted by the Board as proposed by the committee, and, as far as can be inferred from its operation, it is believed that, with such improvements as practical experience may suggest, it will fully realize the advantages expected from it, and effect all the security of which the case is susceptible. It may be further observed that, although in the execution of the system, the duties of some of the old agents were materially changed, and in some instances the employment of new ones was required, yet it has been so arranged, as that by reducing the salary of those whose duties had been lessened, the aggregate expense of the whole is less than was paid under the system it superseded. The report of the chief engineer, acting at present as general superintendent, hereto appended, will not only disclose the present working of the system, so far as tested by practical experience, but also contains, in addition, a general professional exposition, by that officer, of the state of the road and machinery, and of the working and operation during the year; and, by its statements on these points, will dispense with further observations in this report upon the same topics.

SECOND.—*Of the Washington Road.*

The affairs of the Washington road are shown by the statements D and E.

It will appear from these statements that there has been a falling off in the receipts from this road, and that the diminution has been in the passenger traffic. During the past year the number of passengers has been five thousand four hundred and three less than in the year 1846, and the amount of revenue received from this source has been eleven thousand eight hundred and nineteen dollars less than in the preceding year. It may also be stated, that during the past year there was an increase in tonnage transportation of 3,109 tons, and of $2,198·87 in the revenue from that source over the year 1846. It may be inferred, therefore, that the experiment of a reduced charge, authorized by the Board in the years 1845–46, has not realized the expectations by which it was recommended; and the conclusion would seem to be warranted, that the lowest charges do not uniformly increase the amount of travel. It will, therefore, become the duty of the Board to reconsider the subject with the benefit of the experience they have already had, and to make such addition to the present charges as a full investigation may be found to authorize. The net profits from the Washington road, for the last six months, including the surplus of $6,724·19 remaining after the dividend in April last, amount to the sum of $48,131·66, of which the Board have declared a further dividend for the last six months of $2·50 upon each share of stock, leaving a surplus of $6,881·66, to be carried to the account of the current year.

THIRD.—*Of the further prosecution of the Road to the Ohio River.*

Under this head the Board are gratified to be enabled to congratulate the stockholders, that by their action on a recent occasion one of the obstacles that has hitherto retarded the extension of the road to its ultimate destination, has been removed.

By an act of the Legislature of the state of Virginia, passed at the last session, the grant of the right of way through that state has been renewed for a period of twelve years, upon condition that the road shall be extended to the city of Wheeling without touching the Ohio river at a point lower down than the mouth of *Fish* creek; and according to the agreement with that city, the option of extending the road by the latter point is absolute.

The Board is not aware that until very recently any diversity of opinion existed with the public authorities, or in the community at large, of the expediency of extending their road to a southern point on the Ohio, from which they could, with the least competition, command the trade and travel passing up the river, and most certainly form connexions with the improvements of Ohio, upon both the central and southern lines, on which they have been projected in that state. And the Board do not doubt that it is the clear, unquestionable policy and duty of the stockholders, of the state, and especially of this city, by the extension of their road to a southern point on the river, to attract the western improvements from any other point to which they might possibly be diverted, and at which they would be brought within the attraction of the rival cities north of Baltimore. A connexion with the western roads in the state of Ohio, upon either the central or southern line, in that state, would be indispensable to the success of this enterprise, and its ultimate object could be most effectually obtained by extending it so as to connect with both, and without the risk of competition with the northern rivals. In the earlier history of the company, greater reliance than at present was placed upon the river trade and travel, and the city of *Wheeling* was considered by the projectors of the road as not only commanding these, but at the same time insuring a connexion with the railroads on the central line of the Ohio improvements. In all the applications of the company for the right of way through the state of Virginia since the year 1842, however, the company have asked for the option of extending their road to any point on the Ohio within that state they might select above the mouth of the Little Kanawha, intending, undoubtedly, to terminate it at some point within that range of choice. Within those limits the selection must have been, and was expected to be regulated so as to insure a connexion with the Ohio improvements, both on the central and southern lines; and it would have been necessary to avoid a terminus so far south as might force the improvements on the *central* line to a more northern point on the river, beyond the reach of this road. It had been, until recently, supposed that the mouth of *Fishing* creek, twelve miles below *Fish* creek, presented the best medium point for both purposes; and the impression generally prevailed, that while the improvements on the southern line in Ohio could certainly connect more advantageously at *Fishing* creek, those on the central line could also be more easily formed at that point than at Wheeling. From subsequent information, however, it would appear that the *central* improvements in Ohio may connect with this road on the river as advantageously at *Wheeling* as at *Fishing* creek; while it is certain that the improvements projected on the southern line might form a connexion at *Fish* creek, without increasing their length, or the distance between Cincinnati and Baltimore more than twelve miles.

The distance from Cincinnati to Baltimore on the southern line through Ohio, by the mouth of *Fishing* creek, may be stated at 600 miles, and to New York 800 miles; and to Baltimore, by the way of *Fish* creek, 617 miles, and to New York, by the same point, 817 miles. While, therefore, from Cincinnati to New York, by the way of Fishing creek, the distance would be 109 miles less through Baltimore than by the northern route projected to New York, the distance to New York by way of Fish creek would be still 92 miles nearer through Baltimore than by the northern route.

In this view of the subject, and deeming it inexpedient to hazard the extension of their work upon the future legislation of Virginia, the Board thought the prosecution of the road to Wheeling by the mouth of Fish creek would insure, effectually, a connexion with the Ohio works, on both the lines projected in that state, and still enable them to maintain a successful competition with New York.

They do not consider that the projectors of either of the lines in the state of Ohio should attempt or expect to exclude the other from a connexion with this enterprise at a point most acceptable to it; and in the arrangement this company have made with the city of Wheeling, and by accepting the Virginia law subject to its provisions, it must be conceded that the Board and the stockholders have made a better compromise and accomplished more for those interested in the *Southern* line of improvement, than the same parties have been able to effect in any other way. It is to be observed, moreover, that the cost of the work to the Ohio, by *Fish* creek will not be greater than to *Fishing* creek; and that, with the aid of the subscription of half a million of dollars and the gratuitous grant of a depot and right of way to be contributed by Wheeling, the company will not have less ability to execute their engagement with the authorities of that city than if they had succeeded in their object of terminating the road at *Fishing* creek.

It may be assumed, therefore, that in accepting the Virginia law, and confirming the agreement with the city of Wheeling, the stockholders have not only consulted the interests of the several companies engaged in making the improvements on the southern and central lines of Ohio, and insured the connexion of both with their road; but have acquired the right of reaching the Ohio at the point originally contemplated by the state and the city, with the additional and important privilege of extending it twenty-eight miles lower down the river than they originally desired to do or could have done at any time since the spring of 1838. They may thus be enabled to accomplish their original object without the necessity of constructing a rival branch to their main stem, thereby attracting the travel and trade to a rival city; while, by encouraging a connexion of their road with the improvements on the southern line in Ohio, they offer new inducements to the works on the central line to form a similar connexion, in preference to longer and more expensive lines to any Northern point.

Looking to these objects it will now be in the power of the company, by a vigorous and energetic prosecution of their road, in conformity with the law and the agreement with the city of Wheeling, speedily to realize all that ever has been hoped from the enterprise.

It is not to be concealed, however, that for the accomplishment of this object, the united and cordial co-operation of those interested in the prosperity of the company and this city, will be needed; and the Board will not doubt that it will be effectively afforded. For twenty years the stockholders, under the auspices of the state and the city, have been exerting all the means at their command to extend the *Main Stem* of the road to a point on the Ohio not further north than *Wheeling*, and in 1835, the state and the city proposed a liberal amount of aid to effect that object. The universal depression in the public credit which soon followed these efforts, and the expiration of the time limited in the acts of Virginia and Pennsylvania, temporarily defeated the purpose. For the last ten years no exertion has been spared to obtain a renewal of the right of the way, within the limits of the original Virginia grant. These exertions have finally resulted in a choice of routes less restricted than that accepted in 1838,—and not only in confirming the terminus deliberately and definitively adopted in that year, but in enlarging the route, so as to embrace a more southern point, accessible to connexions which might not have been commanded from *Wheeling*. For the accomplishment of this enlarged and more comprehensive object, there will be less distance, and fewer difficulties to overcome, and a less amount of capital to be employed than would have been necessary if the work had been extended under the laws in force from 1838 to 1843; and it is not to be presumed that having succeeded to an extent so much beyond their early hopes and expectations, any of those who have heretofore deemed the completion of the enterprise so essential to the prosperity of Baltimore, will abate any of their zeal and energy. The Board would have greatly mistaken the objects and purport of the trust confided to them, if, succeeding in their efforts, after so much toil and so many discouragements, they were not cordially supported in the prosecution of their work; and the stockholders, if they neglected or failed in the necessary energy to use the opportunity they have deliberately sanctioned, would, in all reasonable probability, forever prevent the extension of the road to any point west of Cumberland. There is no occasion, and the Board have no disposition, to arraign opinions which, amid the uncertainty and discouragement of obtaining the right of a terminus at a southern point, may have grown up in any quarter, favorable to a different and more northern line. So far as such opinions may have sincerely desired an early prosecution of the road to the western waters, and, from an apprehension that, either from the want of authority or of adequate means, the best would not be accessible to the company, advocated the adoption of an inferior line, rather than not go forward, they may be entitled to respect.

Opinions of this description, however, have no longer any reasonable pretext for their maintenance, more especially if an unreasonable persistence in them would most probably entail upon the community even greater mischief than they professed to avert. It is impossible that the subject could have been more thoroughly investigated, or more maturely considered by all that could be expected to take an interest in it. In the various and elaborate discussions to which, through a period of ten years, it has given rise in the legislature of a sister state, and in the mass of facts and information developed in the course of an intelligent and free examination of its merits in this community, every thing that could assist the mind in forming a sound conclusion, has been elicited. The Board are not at liberty to suppose that those who have been called to pronounce their final judgment upon a subject of so much importance, and so deeply involving public and general interests, could be guided by any other considerations than those identified with the successful prosecution of their enterprize, and with the trade and commercial prosperity of this city; and to say that those by whom the ultimate decision was made, thoroughly knew and comprehended the advantages on one side and the hazards upon the other, and perhaps more than any others would seriously suffer from a mistaken course, would only be to say what would be felt and acknowledged by all.

The present enterprise in charge of the stockholders may emphatically be said to be essentially a work upon which the prosperity of Baltimore is dependent. It has already absorbed three millions of capital of individuals interested in the prosperity of the city, and three and a half millions of that of the corporate authorities, to be justified only by such an extension of the road as would increase the trade and augment the value of every species of property; and it must not be overlooked that, of the assessment, in any form whatever, that may be necessary to refund to the state the annual interest upon her loan to the company, a full moiety, at least, must be borne by the authorities and people of Baltimore. In such a case, therefore, whatever diversity of opinion might at any time have prevailed in quarters and upon grounds already alluded to, it would be only reasonable and just towards all the great interests involved, after a final decision of the subject by so large a majority, that all interests would unite in rendering the decision effectual.

It is a great misfortune that ten years have already been spent in seeking the right to extend the road to the Ohio; but if, after obtaining it, upon terms satisfactory to a large proportion of those principally and substantially interested, ten years more are to be wasted in controversies respecting a route, or in excited struggles to reverse the decision already made, it would not only add to the misfortune of the past,—it would be in every view of the subject fatal. In the present condition and progress of improvements in other states, a stationary policy upon the part of this community could not be otherwise than fatal to their prosperity. If they do not now make an effort to extend their great work to the Ohio, other states will soon complete their exertions to attract the trade and travel of the West into other channels, and to cities of greater capital and other advantages, from which we will not be likely at any future day to divert them. That all the advantages, and any amount of trade that could ever have been anticipated from the extension of the road to the Ohio, may be commanded, and at no greater cost, by the route, and at the point selected by the stockholders, has not been, and cannot be denied; and if any attempt to embarrass that selection, by active opposition or a withdrawal of support, by ultimate defeat, or unreasonable delay, can end in any thing short of a total destruction of all the great objects of the enterprise, the Board have not been able to conjecture it. For an object of such magnitude, therefore, appealing to so many interests, promising so many advantages, which, in fact, is so necessary to the commercial prosperity of Baltimore, and to the development of such an important region of the state that could not be developed by any other line of road, the Board must continue to rely upon the cordial co-operation of all those interests which it has been their constant aim to promote.

Thoroughly impressed with a sense of their own duty in this posture of their affairs, the Board are prepared to exert their utmost resources and energies to press forward their work in good faith, in conformity with the authority now conferred upon them, and pursuant to the arrangement with the city of Wheeling. Their last duty, and the first measure devolved upon them, will be by minute instrumental surveys to discover and adopt the cheapest and best line, and to obtain the right of way, and establish the location preparatory to the requisite contracts. Several parties of engineers are now in the field, and it is hoped that the surveys, on the preferred route through this state, to the Virginia line, may be completed during the present year. It would undoubtedly be the duty, and is the wish of the Board to extend the road from the city of Cumberland to Wheeling in part through this state, rather than confine it, as they may do, entirely to the state of Virginia. It has already been hinted that the extension of the road upon the line through Maryland would immediately develope the coal and iron deposits near the Potomac, and the important agricultural resources of the Glades, which would be wholly neglected by a line through Virginia, or even through another part of this state in pursuit of a more northern terminus. On this ground as well as to accelerate the completion of the surveys and the progress of the work, the route through Maryland ought to be preferred. If, however, from any sufficient cause whatever, the Board should be called to leave the state of Maryland, and confine their route to the state of Virginia, their operations would only be retarded. In any event they will indulge the hope of being able to complete the surveys and final arrangements for the right of way, so as to locate the line from Cumberland to Wheeling and place it under contract in the course of the next season.

It will be the duty of the Board to employ the interval in devising the means, and effecting their financial arrangements to prosecute the work with the least possible delay; and although they deem it premature at this time, and in this place, to advert in detail to the various sources and modes of arrangement from which they expect to obtain the means of prosecuting and finishing the road, they have reason to hope that the measures they have in contemplation for those objects will not be unsuccessful. They indulge only a reasonable confidence, moreover, in believing that they will have at their command available and important resources which may be obtained for the prosecution of the road authorized by the Virginia law, and the arrangement with Wheeling, that could not, by possibility, be commanded in aid of a road to a more northern point on the Ohio; and they cherish the hope that the temptation they will be enabled to offer to capital, and the just appeal they may make to all the great interests involved in the accomplishment of the work, will not be made in vain.

In conclusion, the Board can only promise the faithful and energetic performance of so much of the duty appertaining to the prosecution of the work as is devolved upon them. If, after this, the enterprise be destined to failure, the Board, at least, will stand acquitted.

In connexion with this subject, and in further explanation of the recent law of Virginia and the agreement with the city of Wheeling, as well as for the purpose of bringing together the present state of the company's affairs, and the general grounds upon which the stockholders may be supposed to have made their recent decision, the Board have deemed it expedient to append to this report, the report and documents accompanying it, of the committee by whom the arrangement with the city of Wheeling was concluded.

By order of the Board,
LOUIS McLANE, *President.*

October 1st, 1847.

(A)

Dr. *The Baltimore and Ohio Railroad Company.* **Cr.**

Stock in the Washington Branch Road,	$1,032,600·00	Loan at six per cent.,		$1,000,000·00
Cost of road to Harper's Ferry, including real estate and depots, locomotives, passenger and burden cars, &c., &c.,	4,000,000 00	Loan No. 2, at six per cent.,		145,681·53
Cost of road west of Harper's Ferry,	3,623,606·28	Bonds issued indemnified from State and city taxes,		49,105·12
Reconstruction of the road east of Harper's Ferry,	441,991·29	Stock,		7,000,000·00
Sterling bonds in the hands of Messrs. Baring, Brothers & Co., of London,	3,181,005·11	State of Maryland five per cent Sterling bonds,		3,200,000 00
Stock in the Pittsburg and Connellsville Railroad Company,	1,750·00	Baring, Bros. & Co., London, for balance now due,		53,708·95
Sinking fund, for the redemption of the million loan,	76,000·00	Bills payable, for amount of promissory notes out,		109,213 05
Invalid fund, for amount due by that account,	196·28	Forfeited stock, for balance of that account,		183·45
Maryland and New York Iron and Coal Co., due by them,	13,627·69	Revenue, for balance to the credit of that account,	$1,716,450·53	
Cash in the hands of officers,	8.970·87	Less expenses, repairs, and interest, including the sum of $248,250 23, expended for locomotives, burden cars, improvements at depots, and various purposes on account of construction,	839,079·21	
Cash on hand,	*55,515·90			877,371·32
	$12,435,263·42			$12,435,263·42

J. I. Atkinson, *Treasurer.*

Office of the Baltimore and Ohio Railroad Company, Oct. 1st, 1847.

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* To the sum is to be added a dividend of 2½ per cent. from the Washington road, $25,815, and $12,869 51 of debts to be collected, which will make the actual cash balance the sum of $94,200·41.

(B)

Statement of the Revenue and Expenses of the Baltimore and Ohio Railroad Company, on account of the Main Stem of the road, for the year ending the 30th of September, 1847.

The amount received for transportation of Passengers, Mails, and Merchandize, for the year ending the 30th of September, 1847, is . . .	$1,089,067·07	
And the amount yet to be collected from the Post Office Department and Individuals is	12,869·51	
Making, together, the sum of . . .		$1,101,936·58
The expenses, during the same period, for working the Road and Machinery, and keeping them in repair, have been as follow, viz:		
For expenses of Transportation, including Fuel, Salaries of Superintendent, Agents, Conductors, &c.,	$197,134·40	
Repairs of the Road, . . .	131,926·30	
Repairs of Locomotives, . .	74,139·51	
Repairs of Passenger Cars, . . .	26,094·24	
Repairs of Burden Cars, . .	52,209·53	
Repairs of Bridges, . . .	65,363·74	
Repairs of Depots, . . .	16,522·72	
Repairs of Water Stations, . . .	2,450·13	
Watching Bridges, and Pumping Water at the Water Stations, . . .	10,111·33	
Losses by accidents—Fire, &c., . .	2,955·10	
Office and Incidental Expenses, including Salaries, House Rent, Fees to Counsel, &c., . .	11,921·98	
Making an aggregate of expenses of working the road and keeping it in repair, of		590,828·98
And shewing the net earnings for the year to be, .		$511,107·60

J. I. Atkinson, *Treasurer.*

Office of the Baltimore and Ohio Railroad Company, 1*st Oct.*, 1847.

(D)

The Washington Branch Railroad.

Dr.

Cost of road, real estate, engines, and cars, . .	$1,650,000·00
Cash in the hands of officers, ...	68·66
Cash on hand, ...	73,063·00
	$1,723,131·66

Cr.

Stock, ...	$1,650,000·00
Annuity account, ...	25,000·00
Revenue for balance of that account, . . .	48,131 66
	$1,723,131·66

J. I. Atkinson, *Treasurer.*

Office of the Baltimore and Ohio Railroad Co, *Oct.* 1*st*, 1847.

(E)

Statement of the Revenue and Expenses of the Washington Branch of the Baltimore and Ohio Railroad, for the year ending the 30*th of September,* 1847.

The amount received for the transportation of Merchandize, Mails, and Passengers, for the year ending the 30th September, 1847, is		$218,418·31
And the expenses, during the same period, have been as follow, viz:		
For Bonus to the State, one fifth of the Receipts from Passengers, ...	$39,528·30	
Expenses of Transportation, . .	29,364·45	
Repairs of the Road, . . .	18,100·36	
Repairs of Passenger Cars, . .	11,915·16	
Repairs of Burden Cars, . . .	7,625·82	
Repairs of Locomotives, . .	10,117·46	
Repairs of Bridges, . . .	1,908·48	
Repairs of Depots, . .	951·46	
Repairs of Water Stations, . .	423·39	
Elkridge Landing Annuity, . .	1,250·00	
Office and Incidental Expenses, including Salaries, House Rent, Fees to Counsel, &c., .	7,625·87	
Making an aggregate of		$128,810 75
And shewing the net earnings of this road for the year to be		$89,607·56

J. I. Atkinson, *Treasurer.*

Office of the Baltimore and Ohio Railroad Company, Oct. 1*st,* 1847.

Comparative Summary of the operations of the Main Stem *of the Baltimore and Ohio Railroad—from* 1836 *to* 1847, *inclusive.*

Fiscal Years.	FROM PASSENGERS.		FROM TONNAGE.															Aggregate of Passengers and Tonnage.
			WESTWARDLY.				EASTWARDLY.						TOTAL.				AMOUNT from Tonnage.	
	Passengers.	Amount.	Tons.	h.	qr.	lb.	Bbls. Flour.	T's Coal	Tons.	h.	qr.	lb.	Tons.	h.	qr.	lb.		
1836	157,102	$128,126·30	25,898	5	1	0	172,664		40,805	3	3	1	66,703	9	0	1	$153,186·23	$281,312·53
1837	140,699	145,625·29	33,901	5	3	10	113,870		40,696	4	3	5	74,597	10	2	15	155,676·09	301,301·38
1838	150,516½	166,693·53	30,079	11	1	3	142,512		47,447	7	3	24	77,526	19	1	2	198,530·79	365,224·32
1839	152,501	173,860·44	45,878	4	3	10	264,033		54,573	7	1	4	100,451	12	0	14	233,487·06	407,347·50
1840	152,418	177,035·75	25,638	10	0	9	392,449		62,736	3	1	24	88,374	13	2	8	255,847·95	432,883·70
1841	171,629½	179,615·86	23,442	13	0	19	255,818		42,056	4	3	0	65,498	17	3	19	211,454·07	391,069·87
1842	154,568	181,177·35	30,243	15	3	9	233,539		37,600	14	0	19	67,844	16	0	3	245,315·31	426,492·66
1843	149,533	274,617·27	27,191	16	3	3	266,146	4,964	55,523	11	2	20	82,715	8	1	23	300,617·81	575,235·08
1844	173,821	336,876·32	33,224	16	1	2	241,550	5,433	69,886	11	1	23	103,111	7	3	0	321,743·66	658,619·98
1845	202,458½	369,882·30	50,541	16	2	23	235,602	16,020	90,865	3	3	20	141,407	0	2	18	368,720·88	738,603·18
1846	280,264½	413,341·59	83,559	2	3	9	412,776	18,393	110,356	18	0	22	193,916	1	0	6	468,345·94	881,687·53
1847	288,674½	447,020·44	79,510	10	1	8	579,870½	50,259	183,824	8	2	18	263,334	19	0	1	651,916·14	1,101,936·58
Totals.	2,174,185½	$2,993,872·38	189,110	9	1	5	3,310,829½	95,069	836,372	0	1	5	1,325,482	9	2	10	$3,567,841·93	$6,561,714·31

W. S. Woodside.

Office of Transportation,—Baltimore and Ohio Railroad Co., 4th October, 1847.

High Pressure Steam.

The greatest object remaining to be accomplished in navigating the ocean by steam, is unquestionably the *saving of fuel*, and this, to any great extent, can only be effected by using high-pressure steam expansively, by which not only *one-half* of the tonnage occupied at least will be liberated, but *one-half* the cost of the fuel will be saved. We need not expatiate upon the immense importance of such a reduction, both to the naval and commercial marine of this country, particularly where distant depôts have to be so frequently replenished, because that can be duly appreciated by every person practically experienced in steam navigation. But no sooner, however, is the proposition mooted, than a fierce fusilade is opened against so dangerous an innovation, which that is presumed to be,—as if any inherent property existed to render high-pressure steam more dangerous or destructive than steam of low-pressure. This, however, results from prejudice rather than from calm and dispassionate reasoning; in the face, too, of daily experience and the successful operation of hundreds of locomotives gliding over our iron roads at something like 60 miles an hour, notwithstanding the very high power employed, which marine purposes do not require,—that it is really gratifying to read your judicious and pertinent remarks in the case of the late explosion of the Cricket steamboat.

With properly constructed safety-valves, to limit the pressure with certainty, placed beyond the control of the engineman or driver (which is a matter of equal importance in both systems), high steam will prove as safe, nay safer than low-pressure, if generated in suitable boilers; which, we trust, we shall be able to show. We are not aware if there exists any collected record of the number of explosions which have occurred, distinguishing the class to which each belongs, together with the probable cause and circumstances attending them, beyond the transitory and imperfect accounts given in the news of the day; or we believe it would be found, that not only are the most destructive effects produced, but also that two-thirds, possibly three-fourths, are occasioned by low-pressure steam, or by boilers so denominated (see the frightful account of the explosion in the newspapers of to-day—October the 7th—as detailed before the coroner at Leeds). And what would have been the consequence if many low-pressure marine boilers had been subjected to the fool-hardy and reckless treatment practised on board the "Cricket?" Would they have resisted one-half the time those boilers did?—we presume to think not.

Marine boilers of the usual form of construction and magnitude are the worst to resist pressure; and, therefore, in examining the comparative safety of the two systems, we will assume that the boilers are of the same form—viz.: cylindrical (where the tension of the metal is most perfectly applied), and the pressure in one to be four pounds the square inch, and that of the other to be fifty, while the thickness of metal in each shall be in the exact ratio to the strain: thus, multiply the pressure by the radius, and divide the sum by 400 (equal to one-tenth of the strength of the plate for every eighth of its thickness), and the quotient will express the thickness in eighths which the plates of each of the boilers should contain.

Thus, we have two boilers whose power of resistance in relation to their contents are exactly equal; hence, if the fifty pounds steam were to be doubled, the pressure would not be one iota more dangerous than the four pounds steam being increased to eight, and *vice versa*; consequently, in relation to strength, one boiler is as likely to explode as the other: but as neither is likely to take a flight if duly supplied with water, and their safety valves be in good order, we will proceed to consider the result in case of neglect—first, with regard to a deficiency in water, and next to the valves becoming fixed. With respect to a deficient supply of water, the chance of an explosion would probably be pretty nearly equal, and so would be the force, from the larger volume necessarily pent up in low-pressure boilers; indeed, we are not aware that there is any distinction observed in this particular, but in effect the low steam may be assumed to be more disastrous from its scalding property, as you very properly remark, than high-pressure. In respect to the safety valves, we have shown that each boiler is capable of resisting the doubling of the working pressure of its contents, or any other extent in the same ratio, in an equal degree. Now, it is quite possible for a low-pressure valve to adhere to its seat so firmly as to resist the additional four pounds per inch, and even a much greater increase, ere an explosion ensue; but for a valve of a high-pressure boiler to resist an addition of fifty pounds per inch without being unseated, is scarcely within the bounds of probability. All boilers require careful and efficient superintendence most unquestionably, and casualties from neglect will sometimes occur without doubt; but under an equal degree of supervision and skill in construction, we think we are justified in the conclusion that high-pressure steam in regard to safety has the advantage.

The quantity of fuel saved depends upon the just application of the expansive principle; the usual practice is for the pressure in the boiler to be *constant*, and the amount of expansion varied by expansive gear, according to the exigencies of the service. To prove that this is an error, we have only to imagine a cylinder, say four inches long and one in diameter, with steam of four pounds cut off at one quarter its length and allowed to expand to four times its volume, which will exert a mean force of two pounds and a fraction; this we will assume to be the minimum working power of the engine. Now, if circumstances require the maximum power to be applied of four pounds during the whole stroke, it is manifest that a *fourfold* amount of steam will be required, and expansion must be abandoned altogether to effect it when its saving effect is most requisite, as the largest amount of fuel is being consumed. Now, if we reverse these functions, by making the amount of expansion *constant*, and work with a *variable* pressure, it will be found that the steam required will be exactly in the ratio of the work done; thus, if we raise the pressure to *eight pounds*, and cut off the steam as before, we obtain a mean of over four pounds, with just double the quantity of steam, instead of quadruple as above, and of course at one-half the expense of fuel. The pressures here assumed for illustrating the two modes of application are not those, of course, which would be adopted in practice, but the result would be the same in effect if the maximum pressure were sixty-five pounds above vacuum, and the minimum one-half that amount, working with a constant expansion of eight or ten times its original volume.

Now that competition is so strong in rates of speed, every degree of pressure is employed and steam generated in all kinds of boilers, suitable or unsuitable; the temptation is so great to run dangerous risks for the sake of victory, that some power of control is become absolutely necessary—a matter, however, of no very difficult accomplishment, though it might be opposed by the proprietors, possibly, as exposing the secret of the doings in the engine-room, with regard to the real working pressure; but that is a matter of no weight, nor can it be honestly objected to or denied. We would suggest, then, that a competent person should have the power to inspect *all steamboats*, periodically, as to the fitness and condition of the boilers in relation to their working pressure, and to see the following precautionary checks adopted—viz.: One safety-valve, at least, on each boiler, placed beyond the control of the engineer, except as to having the power of lifting it occasionally, to insure its duly operating: or by a slight easement effected at regular intervals by the engine itself, but no power of adding weight. Next, that two graduated gauges be fixed in one case above deck; one showing the pressure of steam in the boilers, and the other the level of the water and the excess or deficiency in either case from the fixed working points on the scale.—These gauges to be open at all times for inspection to every person on board, and minutes made in the log at regular intervals in sea-going steamers, particularly during the night, stating the height of the water and pressure of steam. The sound working condition of these gauges to be maintained at all times, and cases of neglect, or tampering with them in any manner, to be visited by a severe fine—perhaps fine and imprisonment, where so many lives are endangered, which would at once put an end to the reckless tampering with the pressure, and insure careful attention to the supply of water, and consequently safety to all on board. C.

London, October 7, 1847. Civ. Eng. & Arch. Journ.

New Steam Gauge.

The following letter has been addressed to a morning paper:—Sir, A most important invention has been submitted to me for my approval, patented by a Mr. Smith, of Nottingham, and is intended to indicate the strength of steam in steam engine boilers; it is particularly adapted for steamboats, and can be placed in the cabin, on deck, or on any other part of the vessel, where it may be seen by every passenger on board. It may also be fixed in the office of every manufactory where a steam engine is used, at a considerable distance from the boiler. I am so much pleased with it, that I have put one up at one of my own collieries; it is some distance from the boiler, and in another house, and works most beautifully, showing the rise and fall of the steam in the most delicate manner. The indicator is like the face of a clock, with a pointer, making one revolution in measuring from 1 lb. to 100 lbs. upon the square inch of the pressure of steam; it is quite from under the control of the engineer, or any other person, so that its indications may be relied upon, and the construction is so simple that it is scarcely possible for it to get out of order. I might give a full explanation of the machine, but I think it best to leave that to the inventor himself. The numerous and appalling accidents which have occurred from the bursting of steamboat boilers have induced me to give you these observations, which I think desirable to be laid before the public. I may state that I have no pecuniary interest in the scheme; but being the first person to whom it has been shown, and the first to make use of it, I feel it a duty that I owe to the inventor, as well as the public, to make it as universally known as possible. The indicator is put up at Tapton Colliery, near Chesterfield; and may be seen any day by any respectable person by inquiring either for Mr. Hindmarsh or Mr. Langlands.

George Stephenson.

Tapton-house, Chesterfield.

London Athenæum.

AMERICAN PATENTS.

List of American Patents which issued in the month of September, 1846,—with Exemplifications, by Charles M. Keller, *Agent for procuring Patents, and late Chief Examiner of Patents in the U. S. Patent Office.*

1. For *Improvements in the Adjustable Clevis for Ploughs;* Samuel Wilt, Hagerstown, Maryland, September 3.

The patentee says,—"Many modifications of the clevis have been made, by which the plough was to be properly set, but heretofore generally without success, and in many instances the expense of construction was so great that they were not brought into general use By my newly-invented clevis, I am enabled to set the draught up, or down, or sideways, with the utmost exactness, which has not been attained by any clevis now in use."

Claim.—"Having thus fully described my invention, I wish it to be understood that I do not claim adjusting the height of the draught by a screw, nor do I claim regulating the clevis by a slit and set screw, as these have before been done; but what I do claim as my improvement, and desire to secure by letters patent, is the combination of the horizontal and vertical adjusting apparatus, constructed as herein described; by which the adjustment can be made either way with the minutest exactness."

2. For *Improvements in Stump Extractors;* John R. Remington, Lowndes county, Alabama, September 3.

The patentee says,—"The nature of my invention consists in the combination of levers, so arranged as to divide the downward pressure on to two fulcrums instead of one, to shorten the levers and increase their effect, while the whole apparatus is made portable, and can be conveniently transferred from one point to another."

Claim.—"Having thus fully described my improvement, what I claim as my invention, and desire to secure by letters patent, is the combination of levers, as described, constructed and operating substantially in the manner and for the purpose set forth."

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3. For *Improvements in Stoves for Warming Rooms, &c.;* Oliver S. Hartshorn, Henry M. Payson, and Aaron Ring, Portland, Maine, September 3.

Claim.—"The parts of this stove which we claim as our own invention, and desire to secure by the patent to be issued on these specifications, and the drawings accompanying, are the combination of the common wood stove and cylinder coal stove, in the manner described, so that coal may be burnt alone, and the draught so arranged, as specified, as at the same time to heat the wood stove with the same heat; and if wood alone should be burnt, then the draught may be so managed and arranged, as specified, as at the same time to heat the radiator and coal cylinder; and in this case the draught may go from the coal cylinder through the funnel at the top, or that funnel may be closed, and the front of the ash-pit closed, and the funnel from the ash-pit opened, which will give much more heat than to carry the draught off at the top of the coal funnel."

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4. For *Improvements in the Yoke for Yoking Oxen;* David Chappel, Sheldon, Franklin county, Vermont, September 3.

We are under the necessity of omitting the claims, as they refer to, and are dependent on, the drawings. The first section is limited to the use of a sliding block, through which the yoke passes, and which moves on the beam. The second is limited to the use of a movable regulator, attached, by a bolt, on the top of the yoke, and in combination therewith a gauge to be placed on the top of the bows.

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5. For *Improvements in the Machine for Mowing and Reaping Grain, Grass, &c.;* Alexander M. Wilson, New York, September 3.

The patentee says,—"My improvements consist, first, in making the cutting edges of the cutters of a more gradual curve, and rounding off the heel, so as to continue cutting as the machine approaches the uncut grain, or grass, to avoid throwing too much work on the heel part of the cutters, and, at the same time, to bring into action a greater extent of cutting surface for a given size of wheel than could possibly be attained by the previous mode. Secondly, the cutting and gathering wheel has its bearings in the main frame of the machine; and the horses are harnessed to a frame which is jointed to the forward part of the main frame, but back of the centre of the cutting wheel, and extending diagonally to the side, so that the horses are in the swath previously cut, and pass over the irregularities of the surface, leaving the cutters free to follow the undulating surface. Thirdly, I connect the drum of the cutting and gathering wheel to its shaft by means of curved or dished arms, and bend the runners up within the drum, to receive guide-wheels to adapt the cutters to the inequalities of the surface of the ground, instead of relying entirely on the friction of the runners. And, fourthly, I grind the upper beveled edges of the cutters by means of a horizontal rotating grinder, the under surface of which is beveled to the inclination of the beveled faces of the cutters, and combine this with a permanent grinder, over which the cutters pass, to remove the wire edges produced by the rotating grinder."

Claim.—" 1st. What I claim as my invention, and desire to secure by letters patent, is making the heel of the cutters rounded when a number of cutters are combined together on a wheel, to cut grass, or grain, by the rotation and forward movement of the machine, as herein described.

" 2d. I claim jointing the horse frame to the forward part of the main frame, but back of the shaft of the cutting wheel, so as to have the horses placed forward and to the side of the cutters, in combination with a wheel of cutters for cutting grain, or grass, so that the cutters may follow the undulations of the ground independent of, and not affected by, the up and down movement of the horse, as herein described."

"3d. I claim the employment of the guide-wheels, in combination with the cutting and gathering wheel, connected with its shaft by means of curved or dished arms, as herein described.

"4th. I claim, in combination with the curved cutters attached to and forming the cutting wheel, the rotating grinding wheel, for grinding the upper beveled face of the cutters, as described; and, finally, I claim, in combination with this, the grinder for grinding the under surface of the cutters, as described."

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6. For an *Improvement in the Method of Separating the Oleic from the Stearic Acid, in the Manufacture of Candles;* Jas. S. Gwynne, Pittsburg, Pennsylvania, September 3.

Claim.—" What I claim as new, and desire to secure by letters patent, is the application of heat, through a liquid or aeriform medium, to the mass to be pressed, in such a manner that the said mass, before it is subjected to pressure, shall be heated gradually and uniformly throughout to such a degree that while the stearic acid is at no time during the process melted, the oleic acid is rendered fluid enough to be afterwards expressed, in the manner described."

7. For an *Improved Machine for Hulling Rice, Coffee, &c.;* Clark Jacobs, Brooklyn, New York, September 3.

The patentee says,—"The nature of my invention consists in the combination of a conical runner stone with a stationary stone and case, so that the two stones should, by their action, break the hulls of the grain passed between them, and the side case finish the operation of purling."

Claim.—"Having thus fully described my improved machine, what I claim therein as new, and desire to secure by letters patent, is the combination of the stationary stone and the side casing with the conical runner, in the manner and for the purpose set forth."

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8. For an *Improved Sash Fastener;* James Jones, Rochester, New York, September 3.

Claim.—"Having thus fully described the manner in which I construct and use my sash fastener, what I claim as new therein, and desire to secure by letters patent, is the employment or use of the catch, with its hooked end, in combination with the plate, with its mortise, for the purpose of holding the lower sash securely down; the whole being formed, arranged, and combined substantially as set forth."

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9. For *Improvements in the Machinery for preparing the "Blanks" in the Manufacture of Wood Screws;* Thomas W. Harvey, New York, September 3.

The patentee says,—"In my machine for cutting off the wires and for forming the heads thereon, preparatory to the other operations necessary to the perfecting of wood screws, the wire is fed into the machine from two coils, from each of which a wire is alternately cut and headed by the two cutters and one heading punch—the feeding in of one wire being in progress whilst the head is being formed on that previously fed in, an arrangement by which much time is saved, and the heading is more effectively performed."

Claim.—"Having thus fully described the manner in which I construct my machine for preparing the blanks for the formation of wood screws, and which may also be applied to the forming of rivets, and other articles of a like nature, what I claim therein as new, and desire to secure by letters patent, is the manner, herein set forth, of producing the respective alternating motions necessary to the double feeding, by combining the respective arms with the cams, having grooves crossing each other, said cams carrying swiveling cam pins, and operating the rock shafts, which shafts are connected with the respective operating parts of the machine, with the exception of the heading die, substantially in the manner made known. And this I claim, whether said motions be effected by one or more cams of the kind described, whilst the operating parts are substantially the same in their arrangement and action with those described and delineated.

"I also claim the arrangement and combination with the cams and with the respective rock shafts and single heading punch of the double acting apparatus, consisting of the feeding wheels and segments, the cutters, the gripping tumblers, and the sliding die-holder; the whole being made to operate substantially as described."

10. For an *Improvement in the Self-setting Tail-block for SawMills;* Horace Merrell, Wheatland, Monroe county, New York, September 3.

Claim.—"Now what I claim as my invention, or discovery, is the application of the vibrating rack, together with the movable cogs and the movable racks, as described, connected to the mill floor, or timbers, in combination with the lever, wheel, and other appendages, in the manner described."

11. For an *Improved Machine for Fencing and Ditching at one and the same operation;* William C. Bussey, Rockgrove, Illinois, September 3.

The patentee says,—"By my machine, two ditches are cut parallel to each other, and a mound, or ridge, of earth raised between them, all perfectly sodded, and more compact than by the old method."

Claim.—"Having thus fully described my machine and its mode of operation, what I claim therein as new, and desire to secure by letters patent, is the combination of two ditching machines, in the manner described, so that the sods cut from two parallel ditches shall be elevated and placed, with the grass, out in a continuous ridge between said ditches at one operation, in the manner and for the purpose set forth."

12. For an *Improvement in the Machine for Breaking Hemp, &c.;* Thos. L. Fortune, Liberty, Clay county, Missouri, September 3.

Claim.—"Having thus fully described my improved brake, what I claim as my invention, and desire to secure by letters patent, is constructing the brake in the manner described, by curving the swords of the brake convexly from end to end, placing the centre swords higher than the outside ones, as fully set forth."

13. For an *Improved Instrument for taking Measures for Garments;* William R. Acton, Fewcastle, Botetourt county, Virginia, September 5.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the constructing a tailor's measuring instrument by the combination of the elastic metallic plates, self-registering scale straps, and the upper and lower knobs, or pivots, substantially in the manner and for the purpose set forth.

"I also claim the manner of taking the requisite measures for the formation of a coat, by my self-registering instrument, and the combination therewith of a tape measure, with a ring, or loop, at one of its ends, substantially as set forth."

14. For an *Improved Mode of Drawing Wagons, Sleighs, &c.;* Mylo Knapp, Springwater, Livingston county, New York, September 5.

The patentee says,—"The nature of my invention consists in transferring a portion of the load to the collars of horses, or the yokes of oxen, only in the act of drawing."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the lever, roller strap, rollers, clasp, and guard, to be applied to the tongues and shafts of carriages, to produce a proportionate bearing, as described."

15. For an *Improvement in the Mode of Heating Rooms;* John H. B. Latrobe, Baltimore, Maryland, September 5

Claim.—"What I claim as new, and desire to secure by letters patent, is the employment of a stove, such as described, so constructed and placed within the ordinary fireplace as to heat the room by its direct radiation, as well as by heating air entering the room from the outside as described, serving the double purpose of a stove and hot air furnace."

16. For an *Improvement in the Plough for Ploughing Corn, Potatoes, &c.;* John Kranzer & Cyrus Kranzer, Reading, Berks county, Pennsylvania, September 5.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is, first, the knee, or brace, cast on the stand, as explained. Second, the longitudinal openings, together with the metallic boxes."

17. For an *Improvement in Railroad Trucks;* John F. Rodgers, Troy, Rensselaer county, New York, September 5.

Claim.—"Having thus fully described my improved truck, I wish it to be understood that I am aware that trucks have been formed with a single cross, or centre bar, and in such a way as to allow any one of the wheels to rise and fall, as in my construction; but they have all lacked the strength of connexion to render them available, and their expense has been such as to prevent their use; therefore, what I claim as my invention, and desire to secure by letters patent, is the combination of the balance beam with the centre beam, substantially in the manner set forth, by means of the recesses in the centre beam spring plates, having tubes thereon, as described, on which the springs rest, and attached to the beam by bolts, by which a compact and secure connexion is formed, while all the necessary flexibility is preserved."

18. For an *Improvement in Straw Cutters;* G. Catchpole, Geneva, Ontario county, New York, September 5.

Claim.—"Having thus fully described my improvements, what I claim as new therein, and desire to secure by letters patent, is, first, the combination of the sliding gate, front block attached thereto in a stationary manner, and top roller, in the manner described; the said plate sliding in grooves in the outside plates of the frame, by which it is steadied and directed.

"Secondly, I claim constructing the rollers, as described, so that the top roller gathers in faster than the bottom, to prevent clogging, in the manner set forth."

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19. For an *Improvement in Windlass, and other Bedsteads;* Joseph W. Adams, (assignor to Simon H. Lewis & J. C. Clapp,) Boston, Massachusetts, September 10.

The patentee says,—"The great objections which have been met with in the use of windlass bedsteads, as they now are, and have been heretofore, constructed, are, that as the sacking has been merely tacked, or nailed, to the side swell beams, the fabric is liable to break away from the nails, or tacks; and when, for this reason, and for the loosening of the cords which confine the sacking to the end swell beams, or for other reasons, the said sacking becomes loose or slack, the whole frame-work of the bedstead becomes 'ricketty,' so to speak. My improvements are designed to remedy these objections, and consist in a new mechanical arrangement for securing the sacking to the side beams, and a simple additional fastening for securing, more perfectly, the two *side* and two end beams, at their ends, to, or in, the mortises of the upright corner posts of the bedstead."

Claim.—"Having thus described my improvements in windlass, and other bedsteads, I shall state my claim as follows: What I claim as my invention, and desire to have secured to me by letters patent, is the mode, herein above described, (or any other mode substantially the same,) of inserting the confining pins, at the four corners of the bedstead frame, so that when the keys are driven into the holes in the ends of said pins, the strain on the frame all around shall be in the same horizontal plane."

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20. For a *New and Improved Cooking Stove;* William H. Allen, Wellsburg, Virginia, and James Slocum, Brownsville, Pennsylvania, September 10.

The patentees say,—"The nature of our invention consists in constructing a cooking stove in such a manner as that it can be readily changed from a wood to a coal stove, by removing a movable ash-pit hearth, and placing a grate and fire-plates in the front part of the stove, as described."

Claim.—"Having thus fully described our improved cooking stove, what we claim therein as new, and desire to secure by letters patent, is the manner in which we convert a single oven coal stove into a double oven wood stove, by the withdrawal of the grate, and the insertion of the movable ash-pit hearth, arranged, combined, and operating with the air-chamber, or flue-space, substantially as set forth."

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21. For a *Machine for Sewing Seams in Cloths or other articles requiring to be sewed;* Elias Howe, Jr., Cambridge, Middlesex county, Massachusetts, September 10.

The patentee says,—"In sewing a seam with my machine two threads are employed, one of which threads is carried through the cloth by means of a curved needle, the pointed end of which is to pass through said cloth; the needle used has the eye that is to receive the thread within a small distance, say an eighth of an inch, of its inner or pointed end. The other or outer end of the needle is held by an arm that vibrates on a pivot or joint pin, and the curvature of the needle is such as to correspond with the length of the arm as its radius. When the thread is carried through the cloth, which may be done to the distance of about three-fourths of an inch, the thread will be stretched above the curved needle, something in the manner of a bowstring, leaving a small open space between the two. A small shuttle, carrying a bobbin filled with silk or thread, is then made to pass entirely through this open space, between the needle and the thread which it carries; and when the shuttle is returned, which is done by means of a picker staff or shuttle-driver, the thread which was carried in by the needle is surrounded by that received from the shuttle; and as the needle is drawn out, it forces that which was received from the shuttle into the body of the cloth: and, as this operation is repeated, a seam is formed which has on each side of the cloth the same appearance as that given by stitching; with this peculiarity, that the thread shown on one side of the cloth is exclusively that which was given out by the needle, and the thread seen on the other side is exclusively that which was given out by the shuttle. It will, therefore, be seen that a stitch is made at every back and forth movement of the shuttle. The two thicknesses of cloth that are to be sewed are held upon pointed wires, which project out from a metallic plate, like the teeth of a comb, but at a considerable distance from each other—say three-fourths of an inch, more or less; these pointed wires sustaining the cloth, and answering the purpose of ordinary basting. The metallic plate from which these wires project has numerous holes through it, which answer the purpose of rack-teeth in enabling the plate to be moved forward, by means of a pinion, as the stitches are taken. The distance to which said plate is moved, and consequently the length of the stitches, may be regulated at pleasure."

Claim.—"Having thus fully described the manner in which I construct my machine for sewing seams, and shown the operation thereof, what I claim therein as new, and desire to secure by letters patent, is, first, the forming of the seam, by carrying a thread through the cloth by means of a curved needle on the end of a vibrating arm, and the passing of a shuttle furnished with its bobbin, in the manner set forth, between the needle and the thread which it carries, under a combination and arrangement of parts substantially the same with that described.

"I also claim the lifting of the thread that passes through the needle eye by means of the lifting rod, for the purpose of forming a loop of loose thread that is to be subsequently drawn in by the passage of the shuttle, as herein fully described; said lifting rod being furnished with a lifting pin, and governed in its motions by the guide pieces and other devices, arranged and operating substantially as described.

"I claim the holding of the thread that is given out by the shuttle so as to prevent its unwinding from the shuttle bobbin after the shuttle has passed through the loop, said thread being held by means of the lever or clipping piece, as herein made known, or in any other manner that is substantially the same in its operation and result.

"I claim the manner of arranging and combining the small lever with the sliding box, in combination with the spring piece, for the purpose of tightening the stitch as the needle is retracted, as described.

"I claim the holding of the cloth to be sewn by the use of a basterplate, furnished with points for that purpose, and with holes, enabling it to operate as a rack in the manner set forth, thereby carrying the cloth forward, and dispensing altogether with the necessity of basting the parts together."

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22. For a *Machine for Excavating and Embanking Ditches;* Samuel Thrailkill, LaFayette, Indiana, September 10.

The patentee says,—"My first improvement consists in connecting the mould board, or winding trough which carries up the earth and delivers it on the side of the ditch to form the embankment, with the share, by means of a hinged joint, so that this part of the machine can be elevated or depressed to adapt it to the forming of any depth of ditch. My second improvement consists in adapting to the forward part of the board which carries the forward end of the side cutters that form the side of the ditch, two rollers or wheels, the axles of which are hung in vibrating frames, each connected by a stirrup with a screw that is tapped, through an arber that turns in standards, so that by the turning of the screws the rollers can be elevated or depressed at pleasure, to increase or decrease the depth of the ditch. And my third improvement consists in making the cutting edges of the two inclined side cutters with offsets or teeth to increase their capacity for cutting."

Claim.—"I claim, in combination with the adjustable mould board, adjusting the depth of the forward part of the machine, substantially as described."

23. For an *Improved Spark Arrester;* Augustus Hamann, Washington, District of Columbia, September 10.

Claim.—"Having thus fully described my improved apparatus, what I claim therein as new, and desire to secure by letters patent, is the combination of the pipes *c* and E, the box *i*, and pipe *n*, constructed substantially in the manner and for the purpose herein fully set forth, so as to cause a sufficient draught, and at the same time to arrest the sparks."

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24. For an *Improved manner of Manufacturing Artificial Burr Stones;* Ezekiel Cutter and Stephen Blanchard, Cincinnati, Ohio, September 10.

Claim.—" Having thus fully set forth the nature of our new manufacture of artificial burr millstones, and shown the manner in which we effect the same, what we claim therein as new, and desire to secure by letters patent, is the preparing of such artificial burr stones, by incorporating with clay, or such earth as is fitted for making the harder kinds of pottery, a large portion of fragmentary vegetables, or such other suitable matter as will cause the said clays, when burnt, to be filled with pores of the kind by which it is adapted to take the place of the natural burr stone; the whole procedure and operation being substantially the same with that herein fully made known."

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25. For an *Improved mode of Curing Meat in Vacuum;* Augustus C. Allen, Houston, Texas, September 10.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the mode by which I obtain a vacuum in meat vat A, for curing meat, by exhausting the brine from meat vat A, into brine vat B, and by means of the combination of stop-cock P and pipe K, connecting vat A with vat B, and stop-cock L, in pipe N, I, substantially as above described."

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26. For an *Improved mode of forming a Grinding Surface in Mills;* Jesse Fitzgerald, New York, September 12.

Claim.—" Now what I claim as my invention, and wish to secure by letters patent. is the use of French burr stones, or of a similar material, not in blocks, but in small pieces, heretofore considered useless, and setting these pieces in an external frame, of the shape of a cone or cylinder, so as to form a grinding surface that will cost far less than a similar surface formed in any other way hitherto employed."

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27. For an *Improvement in Printing Presses;* William W. Marston, New York, September 12.

Claim.—" I do not claim the invention of printing by machiner those necessary parts common to printing machines, taken in connexion with the parts substituted by me for others necessary to make one machine; but what I do claim as my invention, and desire to secure by letters patent, is the use of a vibrating cylinder or cylindrical segment having two sets of grippers, constructed as described; also, the application of revolving cylindric brushes in the manner described; and, finally, the use of adjustable weights in connexion with the vibrating cylinder or segment; the whole being constructed, combined, and operating substantially in the manner set forth."

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28. For an *Improved Balance for Weighing;* Joshua Gibbs, Newark, Ohio, September 12.

The patentee says,—" The nature of my improvement consists in the manner in which I have attached the scale beam to the platform balance, so that it can be turned in any horizontal position to weigh with."

Claim.—" What I claim as my invention, and desire to secure by letters patent, is combining the scale beam with the platform balance, in the manner described, so as to be turned into any horizontal position, the whole being constructed as herein set forth."

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29. For a *Machine for Scouring and Dusting Mill Feed after Bolting;* Edward Bradfield, Rochester, New York, September 15.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is constructing the inside cylinder with a combination of cards and hair brushes; also, in combination with the above, the flat screen, the double separator, the spring beater, and the manner in which the outside cylinder revolves on the cylindrical journals, without coming in contact with the shaft; all as herein set forth, for the purpose herein described."

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30. For an *Improvement in the Manner of Constructing a Coffer Dam;* Sam'l S. Walley, Charlestown, Pennsylvania, September 12.

Claim.—" Having thus fully described the manner in which I construct and employ my portable coffer dam, what I claim therein as new, and desire to secure by letters patent, is the manner in which I have arranged and combined the respective parts thereof, so as to adapt it to the purpose intended as herein made known; that is to say, I claim in combination the providing of the inner box or coffer with doors at its lower part, which, when closed, will convert it into a buoyant vessel, said coffer being provided with elastic padding on its lower edge, and troughs or boxes capable of receiving such load of stone, or other materials as will sink, and press the coffer down upon the bottom of the stream or other water, as herein fully made known, and the expedient of letting in the water to fill the said boxes to increase the pressure, and the pumping out of said water to render it more buoyant."

31. For an *Improved Self-cleaning Blacksmith's Forge or Furnace;* James R. Hobbs, Huntsville, Alabama, September 15.

The patentee says,—"The nature of my invention consists in constructing a blacksmith's furnace in such a manner that the fire chamber will keep itself perfectly clear of ashes and cinders, and in so arranging the grating and furnace that the atmosphere shall circulate through and around them in such a manner as to regulate their temperature, and prevent their being injured or destroyed by intense heat."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the introduction of a blacksmith's furnace in such a manner as to allow the cinders and ashes to freely escape, and prevent their clogging the fire chambers, by placing grate bars at its base, opening into an open air chamber, (leading out at the side of the forge,) and the admitting the blast through the sides of the fire chamber above the top of the grate bars, substantially as herein set forth."

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32. For an *Improvement in Steelyards;* Thaddeus Fairbanks, St. Johnsbury, Vermont, September 15.

Claim.—"My improvement, and therefore that which I claim, consists in the auxiliary scale and weight, as combined and operating with the main weight, substantially in the manner and for the purpose as above specified."

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33. For an *Improved Corn Plough and Cultivator;* Isaac Edwards, Orange county, Indiana, September 19.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of combining the hooks, and eyes, and clevis, as described, by which the sides of the plough may be elevated and raised out of the ground, so as to conform to the inequalities and irregularities in the corn rows, without disturbing the other parts of the machine, and without the necessity of raising the entire plough."

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34. For an *Improvement in the Bee Hive;* William Whitcomb, Grafton, Vermont, September 19.

The patentee says,—"The peculiar nature of my improvement consists in the manner in which I have arranged the cases of the drawers of the hive in the same; the said arrangement, very simple as it may appear, enabling me to obtain very great advantages in the management and operations of the bees."

Claim.—"I do not claim the employment (in a hive) of drawers and boxes, and cases to receive them, as I am well aware that such are old and common devices; but that which I do claim, is my improved manner of arranging each box, and its case in the main chamber of the hive, as described; that is to say, the so disposing them therein, that two diagonal flues, passing through their corners, shall be respectively parallel to the bottom and sides of the hive, substantially as specified."

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35. For an *Improved Projectile, for Killing Whales or other Fish;* Oliver Allen, Norwich, Connecticut, September 19.

Claim.—"Having thus described my invention, I shall claim the lance head, the cylindrical barrel, or bomb, and the priming tube, in combination with one another, and arranged and operating together substantially as set forth."

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36. For an *Improved Reciprocating Steam Engine;* Daniel Barnum, New York, September 19.

The inventor says he has "invented and made certain new and useful improvements in the mechanical arrangement, construction, application, and combination of the parts of steam engines that are intended to work by the action of steam, admitted into one cylinder at a given pressure, and in the progress of the stroke, or half-revolution, the communication with the boiler is cut off, and the steam is allowed to pass into a second cylinder and work expansively, which has been done before by others, but not in the manner invented by me, the first difference between my hereinafter described invention, and nearly all that have preceded it, being that I use two parallel and equal-sized cylinders, set along side of each other. The second difference is, that with these two cylinders, I use only one induction steam pipe from the boiler, and one eduction pipe from the cylinders to the atmosphere, or a condenser. The third difference is, that the steam is admitted by a proper induction valve, to about the half length of the first cylinder; the induction valve is then closed, and an expansion valve simultaneously opened from the first to the second cylinder. Thus the operation of the steam, commencing at the same end of both cylinders, forms the fourth difference between my plans and those of others, and the expansion valve is sustained open, so that the steam shall act expansively during the remainder travel of the first piston, and shall also propel the pistons both in the same direction, during a large portion of the travel, or stroke, of each, without reacting from one piston upon the other, which constitutes a fifth difference between this invention and others which have preceded it. The exhaust valves operate to exhaust both cylinders to the air, or to a condenser, at the same time, from the same end of each cylinder to the same said pipe, and this constitutes a sixth difference between this and other plans preceding it; a large portion of these ends being attained by placing the piston rods in connexion with two cranks on one main or driving shaft; which two cranks are to be placed either at right angles, or at some acute or lessening angle, less than ninety degrees apart, which is believed to be the seventh clear and distinct difference between these arrangements and any that have preceded them. It is well known that double engines have been made to act with either equal or unequal cylinders, upon cranks set at opposite points in the same line, with valves and openings that pass the steam from the top of the first piston to the bottom of the second, and *vice versa ;* and three-fold engines, having cranks more than ninety degrees apart, have been used; and marine engines, with cranks set at ninety degrees apart, each operated by a separate and unconnected cylinder, are in common use; yet no one of these operates in the manner herein proposed ; the nearest approach to which has been made with two cylinders and pistons operating on a pair of right-angled cranks, the valves set to admit the steam from the boiler only when the first crank had passed upwards or downwards to an angle of forty-five degrees, and at one hundred and thirty-five degrees passing the steam expansively from the first to the second cylinder, to the end of the stroke of the first piston, and thus making the second piston carry the first crank past the dead centres, each piston traveling without steam operating on it during the first quarter of each stroke. All these and many other modifications of steam engines, for the same end, are variant from my invention and improvements, by not acting in so direct concert to produce an expansive, direct, and continuous action of the steam in the same direction, or both pistons through the relative positions of the cylinders and cranks, and the arrangement and combination of the acting parts.''

Claim.—"Having, in the commencement of this specification, set forth the general differences between these arrangements, and those that have preceded them, it will be understood that I do not claim to have originally invented an expansively acting steam engine ; neither do I claim to have invented any of the parts herein described, as used by me for these purposes, the whole of them having been long well known and in general use; neither do I claim the application of two cylinders with a pair of cranks irrespective of an arrangement for the admission of the steam from the first cylinder into the second at the half stroke (more or less) of the first piston; but I do claim as new, and of my own invention, and desire to secure by letters patent—

"First. The mode of constructing and arranging two steam cylinders, side by side, with steam passages from one to the other direct, at each end, in combination with valves so arranged and operated as to admit the steam from the boiler into one cylinder only, and from that one into the same end of the other cylinder at the half stroke (more or less) of the piston of the first cylinder, substantially as described and shown.

"Second. I claim as new the mode of working the expansion and exhaust valves, contradistinguished from the working of all other valves, they each being opened by the toe of one rock-shaft, in advance of the regular, or usual, period; the one, at the proper time to allow the steam to pass into the second cylinder, to act by expansion, and the other, at the proper time to prevent the compression of steam, or reaction between the two pistons; from which toes the valves are each taken by a toe of another rock-shaft, for the purpose of being sustained, and kept open, the requisite length of time for the attainment of the ends sought, as described and shown.

"Third. I claim as new the arrangement for disconnecting the two cylinders, by simply opening the exhaust valves to the second cylinder, and unhooking the eccentric which works the expansion valves between the two cylinders, where the first cylinder is used, as a single engine, worked in the ordinary way or by hand, for the purpose of reversing the motion, or stopping, or starting, the engine, as described and shown.

"Fourth, and lastly. I claim the arrangement and application of the several parts with each other which I have above described and set out as new; in combination with a pair of cranks which are attached to one main, or driving shaft, set to a right angle, or either more or less than a right angle, with each other, for the purpose of working the pistons of the two cylinders in the same direction by the primary and expansive action of the steam, and exhausting to the air, or a condenser, forming a vacuum, each working by one channel from the same end of the two cylinders at the same time, substantially as described and shown."

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37. For an *Improvement in the Machine for Cutting Straw;* Isaac Mayfield, Elkton, Kentucky, September 19.

The patentee says,—"The nature of my invention and improvement consists in compressing the article to be cut at the mouth of the box, at the moment of cutting, or descent of the knives, by means of a presser of a prismoidal shape, caused to move in the arc of a circle by mechanical means; said presser being attached to a horizontal transverse bar, by rods, said bar having two parallel arms moving on centres, or pins, attached to a vertically sliding frame containing the bearings of the feed roller; said bar, to which the presser is attached, and into which said arms are inserted, being caused to move in the arc of a circle, by means of a rod, or sweep, attached to it and to the top of a vertical lever, that has a vibratory movement on a bolt, or pin, inserted into the side of the cutting-box; the lower end of said lever being connected by a rod, to one end of a horizontal vibrating lever that turns on a vertical bolt at the rear end of the cutting-box, the other end of said lever having a vertical pin, or cog, which enters a serpentine groove made in the periphery of a revolving cylinder fixed on the end of a horizontal crank shaft, to which the revolving cutting wheel is affixed."

Claim.—"From the foregoing description, it will be seen that the motions of feeding and pressing are not only positive, (effected by the motion of the serpentine grooved wheel, levers, rods, &c.,) but completely alternate and independent of each other. During the operation of pressing, the feeding roller is stationary, and during the raising of the presser the feed roller is in action. I do not intend to claim the principle of compressing the straw at the mouth of the cutting-box at the moment the knives pass through the straw, as I am aware that this has been done in various ways; for instance, by the treadle, by hand rake, and lastly, by levers and cams; but what I do claim as my invention, and desire to secure by letters patent, is—

"First. The combination and arrangement of levers and rods, and reaching arm, and serpentine grooved wheel, as described, for raising the presser and turning the feed roller simultaneously, and for bringing down the presser at the moment the feed, or reaching arm, slides loosely over the teeth of the rag wheel.

Second. Constructing the feed roller with *curved* teeth, in the manner and for the purpose described, for raking forward the straw without causing it to become entangled upon the teeth, or roller, as described.

"Third. I also claim the combination of the shaft-edged triangular shaped plates, or stops, with the steel plate, at the mouth of the cutting-box, constructed, arranged, and operating in the manner set forth."

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38. For an *Improved Mode of Applying Power to Fire Engines;* Gardner Barton, Jr., and Lysander Button, Waterford, New York, September 19.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination, arrangement, and application of the outside lever, as described, and their agreement with the inside levers, in such manner that when force is applied to the hand poles of the inside levers, both powers will agree in forcing the piston of the pump in one and the same direction, while the reverse motion of the levers will prevent the engine from rocking."

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39. For *Improvement in the Double Seaming Machine;* George R. Moore, Philadelphia, Pennsylvania, September 19.

Claim.—"Having thus fully described my invention, what I claim as my invention, and desire to secure by letters patent, is the combination of the roller with the head, constructed and arranged substantially in the manner and for the purpose set forth.

"I further claim the combination and arrangement of the gauge, in the manner and for the purpose described, supporting the inside of the vessel at the bottom while being operated upon, when the sides thereof are flaring.

"And lastly, I claim the employment of the shoulder which terminates the base of the conical part of the head, to keep the bottom in place while making the first bend, as described."

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40. For an *Improvement in the Construction of Head Blocks for Log Carriages for Saw Mills;* Henry Mellish, Walpole, New Hampshire, September 19.

Claim.—"What I claim, and desire to secure, as my invention, by letters patent, is the reversed rows of teeth on the under side of the slide, the jack, and the angular lever, and the dog for moving and setting the slide, the horizontal bar, on which the lever rides, for guiding the jack in the direction parallel to that of the slide, and the movable fulcrum in its block, for gauging the thickness of the stuff to be sawed, and it is to be expressly understood that I claim them not separately, but in combination, substantially in the manner and for the purpose set forth."

41. For an *Improvement in the Glass Furnace;* Thomas Leighton, East Cambridge, Massachusetts, assignor to the New England Glass Company, September 19.

Claim.—"Having thus described my invention, that which I claim is my improved mode of arranging the base hole or fuel opening of the fireplace, with respect to the siege and the cave of the furnace, viz.: the placing it below the siege, and in the cave, substantially as above specified."

42. For an *Improvement in Cooking Stoves;* Jacob Cornelison, Danville, Pennsylvania, September 26.

The patentee says,—"The nature of my improvement consists in the combination and arrangement of the flues, in a stove having two ovens, with the fire between them so as to distribute the heat equally around either or both."

Claim.—"Having thus described my improvement, what I claim as my invention, and desire to secure by letters patent, is the construction and arrangement of the flues, combined in the manner described, with the double oven stove, having a fire chamber between them."

43. For an *Improvement in the Machine for Rolling Iron;* Benjamin Norton, Boonton, New Jersey, September 26.

The patentee says,—"In rolling the billets of iron that are to be converted into hoop iron, or into scroll, band, or other iron of a like character, the apparatus used, as ordinarily constructed, consists of three rollers, the axes of which are in the same vertical plane. The billet is passed through a groove in the lowermost pair, and is returned through a groove in the uppermost pair, by which it is prepared to be passed through the smooth or finishing rollers. In my improved apparatus I use but two rollers in which the billet is first passed in the usual way; as it passes from between these rollers on the rear side, it enters a curved trough which I call a receiver, and this trough conducts it round the rear side of the upper roller towards the workman in front, who passes it into the groove in the first instance, and who then passes it into a second groove formed in the same rollers;" by which arrangement much time and friction is saved and other obvious advantages obtained.

Claim.—"Having thus fully described the nature of my improvement in the manner of constructing and combining the rollers and other apparatus used in the rolling of hoop-iron, what I claim therein as new, and desire to secure by letters patent, is the combining of the covered trough or receiver with a pair of rollers, for the purpose of conveying the strand to the front of the rollers, in combination with the employment of the second groove or grooves, in the lower roller, and thereby admitting of the widening out of the collars,—the said combination and arrangement being made substantially in the manner and for the purpose herein fully made known; not intending, however, to limit myself to the exact form of the receiver, as described and expressed, as this may be varied without changing the principle."

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44. For an *Improvement in the Construction of that part of the Hame, commonly called the "Clip" of the common Hame in Hame Harnesses;* Kasson Frazer, Fayetteville, New York, September 26.

The patentee defines the "clip" to be "that part of the common hame which connects the hame tug to the hame wood by a rivet or rivets as the case may be;" and further says his invention "consists in so constructing the 'clip' in a circular form at the forward end as to prevent it from passing inwards upon the collar of the harness and the shoulder of the horse. I call my invention the 'circular self-adjusting clip.'"

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the attaching the curved clips to the front sides of the hames, by means of double joints, so as to render themselves adjustable, and to keep the draught directly in a line from the point of attachment of the clips to the hames, to the point of attachment of the tugs to the whiffletree, in the manner and for the purpose herein set forth."

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45. For an *Improved Apparatus for Drying Grain;* William W. Alcott, Boston, Massachusetts, September 26.

Claim.—"Having thus described my invention, I wish it distinctly understood that I do not intend to confine myself to the precise mode of constructing it as above detailed, but to vary the same in such manner as I may hereafter deem requisite, so long as I do not change its principle, new features, or novelty of action.

"What I claim is a series of two or more hollow cylinders, or other proper shaped vessels, as combined, arranged, connected, and operating together, and with a hot air chamber, or any proper equivalent therefor, substantially in the manner and for the purpose of acting upon grain or other matter, (to be dried by exposure to heat or hot air,) as above specified. I also claim the combination with the cylinders, or other shafts, of suitable mechanism, (such as the wedges and other contrivances as above described, or any proper equivalents,) by which the ends of the said shafts may be elevated or depressed, in order to change the angles of inclination of the said shafts, or either of them, to the horizontal, and thereby cause the grain or other matter to move faster or slower through the cylinder, according to the velocity required during the operations of drying the same."

46. For an *Improved Plan for Locking Drays, Carts, &c., called the "Self-operating Lock;"* Elijah Chapman, Akron, Ohio, September 26.

Claim.—"What I claim to be my invention is the combination of the bars, rods, and springs, and the levers, for the purpose of making pressure on opposite sides of the wheels, whenever the brake is operated."

47. For an *Improvement in the Construction of Rotary Steam Engines;* James Miller, Philadelphia, Pennsylvania, September 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination with the revolving disk, in rotary steam engines, of a valve having the form herein described, or any modification thereof analogous in design and effect, by which the pressure of the steam upon the valve is directed wholly or mainly towards its centre or axis of motion, and upon its axle, and (for the purpose of avoiding friction) only so much on the sliding part as may be desirable or necessary to keep the valve closed on the sliding surface against the revolver.

"I also claim the combination and arrangement of three cams within two valves, constructed as herein set forth, and escapes for the steam at recesses behind the valves, as herein described."

48. For an *Improved Kiln Drying Apparatus;* Sebre Howard, Adrian, Michigan, September 26.

Claim.—"Having thus fully described the construction and operation of my rotary cylindrical grain dryer, what I claim therein as new, and desire to secure by letters patent, is the uniting the cylindrical casings with each other, and combining them with the furnace in such a manner as to form a circular heating or drying chamber within the inner casing, an annular space or drying chamber connected with the same, between the outer casing and central casing, and an annular flue space between the central casing and inner casing, substantially as herein set forth.

"I also claim the giving the grain or other substance acted upon a constantly progressive rotary movement from the front to the rear end of the circular drying chamber, conducting it into the annular space or drying chamber, and returning the same by a reversed movement to its front end, discharging the kiln dried grain at the spout, by the action of the projecting spiral thread, connecting pipes and spiral thread, combined and operating substantially in the manner and for the purpose herein set forth."

49. For an *Improved Machine for Carding Wool, Cotton, and other Fibrous Substances;* Charles Bishop, Newtown, Connecticut, September 26.

The patentee says,—"The object of my invention is to make the action of the card teeth on the fibres continuous, and so to arrange them that a greater portion of the teeth shall be in active service than can be effected by the present method ; and this I effect by placing the card teeth on a series of endless belts, which pass around rollers with the surfaces of the belts thus covered with teeth, running in contact along the straight surfaces between the rollers around which they pass, which prevents the card teeth from converging or diverging as when placed on curved surfaces."

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the method herein described of carding fibrous substances by the action of the straight surface of a belt of cards, stretched and carried around rollers, when this is combined with one or more similar belts of cards, substantially as herein described.

" And I also claim, in combination with such belts of cards, the tables employed for keeping their acting surfaces in the proper line of action, substantially as described."

List of American Patents which issued in the month of May, 1842, *with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

(Continued from Vol. XIV, page 188.)

40. For an *Improvement in Solar Lamps;* B. H. Horn, Boston, Massachusetts, May 26.

Claim.—" Having thus described my improvements, I shall only claim, as my invention, arranging or forming a trough on the exterior of the fountain, substantially in the manner and for the purpose specified.

"Also, the employment, or arrangement, of an auxiliary, or secondary, lamp, (for the purpose of melting, or liquifying, the concrete substance in the main lamp,) just beneath the fountain of said main lamp, and so that the flame of the former may extend up into the interior tube of the burner of the latter, the construction and operation of the same being substantially as set forth.

" I also claim extinguishing the flame of the auxiliary lamp, and preventing the evaporation of the liquid in the fountain of the same, by means of a sliding lever valve, arranged and operating substantially as described."

41. For an *Improved Hot Air and Cooking Furnace;* Otis Packard, Roxbury, Massachusetts, May 26.

The claim is omitted, as it could not be understood without the drawings.

42. For an *Improved Machine for Sawing Boats' Oars from Plank, or Timber;* John Benson and Ezekiel Page, Boston, Massachusetts, and Richard T. Tough, West Leyden, New York, May 26.

The patentees say,—" Heretofore it has been customary to divide a plank from which oars are to be made into pieces of a width equal to that of the *blade* of the oar, which blade is generally in width double that of the widest part of the rest of the oar. Our method is to separate the plank into strips, in such manner that we obtain nearly double the number of oars from it than by any of the modes heretofore practised."

Claim.—"Having thus fully described our improvements, we shall claim the above described method of dividing a plank into parts, or pieces, from which oars may be manufactured; also, the manner of effecting the lateral movement of the carriage of the sawing machinery, by supporting said carriage on the inclined and declined rails, the whole being substantially as set forth."

43. For *Improvements in Lamps;* Archibald H. Baird, New York, May 26.

The patentee says,—"The nature of my invention and improvement is in certain new and useful combinations of metallic yoke-shaped conductors with the ordinary burners, for conducting the heat to the parts of the lamp in contact with the lard, or the vessels in which they are placed."

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is making the button a heater, by means of the copper yoke in combination with the inner tube and perforated outer tube in Argand lamps, for burning lard, as described."

44. For an *Improved Mode of Constructing Bee Hives;* Elijah Grumman, Norwalk, Connecticut, May 26.

Claim.—"What I claim as my invention, and not previously known in the above described hive, is the combination of several boxes of the form above specified, supported as above described, with the ash-box, or trap, above described, for the purposes which are referred to in the specification."

45. For an *Improved Mode of Making Gloves, Hose, Coats, and other articles of Wearing Apparel, of which Wool, Hair, or Fur is the principal or only Material;* Marmaduke Osborne, May 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the making of gloves, coats, hose, or other articles of wearing apparel, of which wool, hair, or fur is the only material, by uniting, by any process of felting, the bats of which any such article is composed, in a flat, or projecting seam, and by cutting away the superfluous parts after such seam is formed by felting, as above described, and without the folding, or turning over, of the edges, or margins, of the bats, which is used in the ordinary process of making bats."

46. For an *Improvement in the Corn Cultivator;* Asa Wood, David Wells & Issachar Bates, of Adams, New York, May 28.

The patentees say,—"The hind teeth are made of cast iron, in the form of an iron plough, with land-side, mould-board, and false point, to be used that they may turn the furrow inwards, (that is, towards each other,) or outwards, (that is, from each other,) by changing the teeth from side to side. The fore tooth is to be also made of cast iron, and differs from the hind tooth in these particulars—that, as the hind teeth each have a land-side, and mould-board, and false point, the fore tooth is made with a *double* mould-board and false point, that cuts and turns the furrow each way."

The claim is to the combination, in one frame, of these teeth, such as are above described.

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47. For *Improvements in Machinery for Ruling Letter Paper;* Geo. L. Wright, Springfield, Massachusetts, May 28.

Claim.—"Having thus described my invention, I shall claim the two cylinders, A, and B,—arranged so that the lowest edge or part of the upper shall be situated at a distance from the upper edge of the lower cylinder equal to, or a little greater than, the length of the sheets to be ruled, said length being taken in the direction in which the sheets move, and said edges of said cylinders being in, or about in, a horizontal plane, and so that the cylinder B shall have a velocity double that of A—in combination with the system of rollers and cords, whereby the sheets are received from an endless feeding apron, upon which they are placed so as to lap over each other, and from thence, are caused to pass around the first cylinder, and be ruled thereon, upon one half of one of their sides, and from thence to pass around the second cylinder, and be ruled over the whole of their opposite sides, as before set forth; the whole being arranged and operating substantially in the manner described."

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48. For an *Improved Grain Cleaner;* Daniel Flickinger and Sebastian Krim, Hanover, Pennsylvania, May 28.

Claim.—"What we claim as our invention, and which we desire to secure by letters patent, is separating garlic from wheat, by passing the grain and garlic between rollers covered with India rubber, or other elastic substance, that will mash the garlic and, at the same time, not injure the wheat, but increase the size of the garlic, and prevent it from passing through the meshes of the inclined screen through which the grain passes, in the manner described, or in any other mode substantially the same; and in combination therewith, the arrangement of the several inclined screens, conducting-boards, spouts, and tubes, as set forth."

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49. For *Improvements in Cultivators;* John Mason, Haddonfield, New Jersey, May 28.

This patent is granted for the addition of bands, as they are termed, hinged to the beam, between the handles, for lifting vines.

50. For an *Improvement in Brushes, for Dressing Warps;* Samuel Taylor, Lowell, Massachusetts, May 28.

The patentee says,—"My invention consists in arranging the bristles between strips of wood, or in parallel grooves formed in the block, or by laying the said strips side by side, and interposing between their extremities, at each end of the brush, small pieces, whose sides are covered with glue, to cause their surfaces in contact with the strips to adhere thereto. The upper parts of each side of the strips, in opposition, are chamfered, or beveled off, so as to form an inverted trapezoidal groove, in which, and among the tops of the bristles, pitch, or cement is poured, by which the bristles are further secured in their respective positions. Each line, or layer, of bristles, when placed between the strips, should be saturated with a mixture of white lead, or other suitable paint, and linseed, or other proper oil, which causes the bristles to cohere, and prevents their displacement by the action of water, or the sizing material used in dressing the warp."

Claim.—"Having thus fully described my invention, I shall claim securing the bristles in position and preventing their displacement by the action of water, or other external cause, by saturating said bristles, when inserted in the block, with paint, or a mixture of white lead, or other suitable substance, and linseed, or other proper oil, *in combination* with the mode, above set forth, of confining their upper ends by cementing them in an inverted trapezoidal groove, the whole process being substantially as above described, so that when a brush for dressing warps has its bristles arranged and confined, as set forth, in long grooves, or in any manner similar thereto, said brush will apply paste, or sizing matter, more perfectly upon the threads of the warp, and be more durable than brushes as generally constructed, as heretofore explained."

51. For an *Improved Stave-dressing Machine;* Samuel Leamed, Ridgeway, New York, May 30; antedated November 30, 1841.

Claim.—"I am aware that machines have been made for dressing staves by forcing them through between knives, by a follower, operated by a rack and pinion, and I do not, therefore, claim this as of my invention; but what I do claim as my invention, and desire to secure by letters patent, is the arrangement for throwing the rack out of gear, by having the receiving box, in which the slide works, hung at one end by a joint, or roll, and the other provided with a stirrup, or staple, in combination with the spring catch on the frame, and the cam-piece, or guard, on the slide in the manner described; and, in combination with the above, I also claim the foot and cross levers, for the purpose of throwing the rack into gear, as described."

52. For *Improvements on his Loom for Weaving Counterpanes, and other Articles;* Erastus B. Bigelow, Lancaster, Massachusetts, May 30; antedated May 1, 1842.

Claim.—"What I claim therefore, as constituting my inventions, and which I desire to secure by letters patent, is the within described manners, or modes, of mounting the loom, and tying up the harness, and of working the same, in which, under its various modifications, I combine a movable harness board, or boards, with one or more leaves of heddles or harness, and with the Jacquard machine in the power loom; such arrangement and combination being substantially the same with that herein described."

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53. For a *Machine for Manufacturing from Wood, such as Cedar, Basswood, Poplar, and other straight-grained Wood, a Commodity to be used as a Substitute for Curled Hair, in Stuffing Cushions, &c.;* William Baker, Utica, New York, May 30: antedated November 30, 1841.

The patentee says,—"The nature of my invention consists in the construction of a machine by which the wood is cut, lengthwise of the grain, into fine threads, or fibres, which are so curled, and crimped, by the same process, that, when in the mass, they constitute a light and elastic article, suitable to the purposes aforesaid."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the fluted cutters with the smooth cutter, for the purposes of producing the article herein described, and their arrangement in the plane stock, as above set forth; together with their adaptation to the uses of the machine, of the apparatus, above described, for holding the timber, and feeding out the same to the plane, as the surface is cut away. The whole being combined and connected with the machine, as herein set forth."

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54. For an *Improved Tent;* James H. Dakin, New Orleans, Louisiana, May 30.

The patentee says,—"The nature of my invention consists in the formation and combination of a light frame-work with a small upright shaft, and arms attached to it by means of hinges and cords, rendering the arms movable from a horizontal to a perpendicular position, and the application of such frame-work to any tent where the covering of the tent is made of cloth, or any flexible, or pliable, material, and formed with any number of sides. A tent so formed, may be suspended from above, or supported from below, as the case may be, and folded up, and expanded, in effect somewhat similar to the folding up and expansion of a common umbrella."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of a light movable frame-work to tents, fixed permanently in the roof, or upper part, of the tent, which will allow the tent to be folded up and closed, or unfolded and formed for occupation and use, at pleasure, as herein described, using, for that purpose, wood, metal, or any other material that will be suitable to accomplish the intended operation and effect."

55. For a *Machine for Grinding and Polishing Saw Plates, &c.;* Richard M. Hoe, New York, May 30.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combining with the reciprocating beds, or tables, or with the revolving disk, or face-plate, the cylindrical lap, herein described, which is made to traverse back and forth upon its axis, and which may be borne up, with any required degree of force, against the article to be ground, or polished, in the manner set forth; the face, or periphery, of said cylindrical lap being composed of a number of separate and distinct plates of metal, which are to constitute the grinding and polishing surfaces, and which are to be held in place by a screw, and by being confined between rims, or in other suitable modes, substantially the same; the distinguishing feature of the said lap being the dividing of its periphery into separate plates, and combining the same together, as herein set forth."

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56. For an *Improved Press, for Pressing Hay, Cotton, &c.;* Caleb Martine, Greensburg, New York, May 30.

The patentee says,—"This improvement is principally in combining the gearing and piston with a turning post, so that the piston can be raised from the box, and turned aside from it, for the purpose of filling the box."

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the mode of turning aside the piston from the box, to fill the same, and returning the piston and gearing to the box, in order to press the hay, by means of the combination of the turning post and beam with the gearing and cogged piston rod."

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57. For an *Improved Lamp for Burning Pine Oil;* Michael Boyd Dyott, Philadelphia, Pennsylvania, May 30.

Claim.—"First, I claim the air regulator, substantially as above described. Second, The combination of the two horizontal plates, the one above, and the other below, or even with, the top of the wick, to regulate the interior draught of the lamp, substantially as above set forth. Third, I claim the mode of regulating the light, by raising or lowering the burner and outside regulating cone combined, the centre plate being, at the time, stationary, substantially as above described. Fourth, I claim the mode of constructing a wick tube, its upper end being conical, or enlarged, so as to admit of a feeder being placed under the wick without enlarging it in diameter, substantially as above set forth."

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58. For *Improvements in Stoves for Culinary and other purposes;* Benjamin Shepard, Boston, Massachusetts, May 30.

Claim.—"Having thus explained my invention, I shall claim surrounding the fire or flue space which encircles the oven, and through which the smoke and heated products of combustion pass from the fireplace to the chimney, by an exterior casing, so as to form another space around said oven, into which atmospheric air may be introduced, and be warmed by contact with the casing, and from thence be conveyed to one or more apartments by pipes suitably arranged, *in combination* with a hot air chamber arranged in rear of the fireplace, and below the smoke passage, and open at bottom, for the free admission of air therein; said two hot air spaces, or chambers, being connected together by one or more suitable pipes, and otherwise arranged substantially as hereinbefore set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

On Reaction Water Wheels.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the subject of Barker's wheel, which, with a few exceptions, appears to be the only reaction wheel noticed in the elementary books till recently, I have seen no notice of any variation in the discharge, caused by variations in the velocity of the wheel; from which I infer that the writers regarded them as uniform in their discharge under all velocities.

In practice, however, it has been observed that, when the wheel runs without resistance to its free motion, the orifice moves with a velocity considerably greater than that due to a pressure of the head of water, and that the discharge is greater than the theoretic discharge.

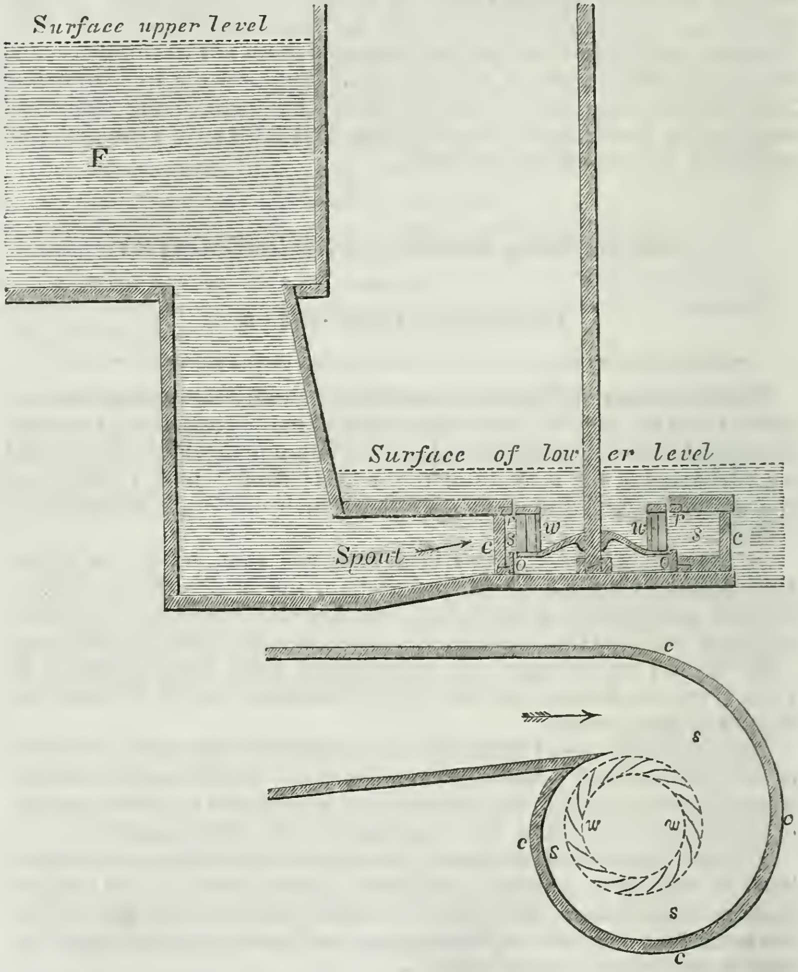
So far as I am informed, no experiments have been recorded, or rules given for determining the ratio of discharge under different velocities of such wheels.

The following rule, I think, will be found to hold good for all wheels of the reaction kind which discharge the water at their verge, and into which it enters without circular motion, or in which a circular motion of the water is caused by the wheel itself—the supply being full:

"To the head of water actually pressing at the orifice, add such a head as will, by its pressure, produce a velocity equal to the circular motion of the orifice; the velocity through the moving orifice will be the same that it would be if stationary, and under the pressure of the sum of the heads: For example:—

Suppose such a wheel to have an issue of 36 square inches, under a head of nine feet, and that the orifice move at the rate of 16 feet per second; the discharge will be the same that it would be if the wheel were standing under a head of 13 feet. Consequently such a wheel would, by this theory, discharge, standing, 6 cubic feet per second, and running at that rate, 7·2 cubic feet. And, if the orifices were suffered to move at the rate of 24 feet per second, the discharge would be the same as if standing under 18 feet head; in which case, the discharge should be 8·48 cubic feet per second.

It is obvious that, in applying this rule in practice, such deductions must be made (as in other cases) as may be due to the form of the orifice, the angles in the passages, and the friction on surfaces.



The following experiments were made with a centre discharge reaction wheel of the form and proportions represented in the accompanying sketch. The wheel was 34 inches in diameter at its outer verge; the inner diameter of the annular rim 26 inches. It had 16 issues, (8 by 1·8 in.) = 230 square inches. It received the water at the verge, from an involute sluice embracing the whole circumference. The water was conducted to the involute through a large spout; the discharge of which into the involute, 24 in. wide by 14 in. deep, = 336 square inches. The terminus of the involute was within an inch of the verge of the wheel. The circular motion of the water caused by the involute coincided with the motion of the wheel.

Power Expended.					Effect Produced.				
No. of Experim'ts.	Fall of water in feet, $= h$.	Cubic feet of Water used per minute, $= d$.	Pounds of Water per minute, $d \times 62{\cdot}5 = w$.	Whole power of water, in lbs. descending 1 ft. per min. $h \times w = p$.	Weight on lever of brake $= w'$.	Revolutions per minute $= v$.	Effective force of wheel, $w' \times v \times 60 = f$.	Ratio or practical co-efficient $=$ R.	Remarks.
1	8·66	1125·5	70,312·5	608,996	30	143	255,600	·411	Good.
2	8·62	1119·0	69,937·5	602,861	39	138	312,920	·518	do.
3	8·61	1119·0	69,937·5	602,861	45	130	351,000	·582	do.
4	8·59	1104·0	69,000·0	592,711	66	87	344,520	·579	do.

The condition of the works at the time the experiments were made was favorable to the wheel. It had run about two months after being repaired and adjusted, and the proprietor, (Mr. A. Atwood, of Troy, N. Y.,) stated that it was performing as well as it ever had. There was a fault, however, in the construction. The "spout" (so called) conducting the water from the flume had an elbow of nearly a right angle, first descending from the bottom of the flume and then passing horizontally to the involute; the section at the commencement of the horizontal portion being about 16 by 36 = 576 square inches. The opening into the "spout" from the bottom of the flume was about 30 inches square, with sharp angles. All things considered, I am of the opinion that this method of employing the "pressure" of water, with a good structure, in good condition, is capable of giving about 62 per cent. of available power.

A remarkable feature of inward-discharging reaction wheels is found in the smallness of their discharge, and its tendency to uniformity under all velocities of the wheel, obviously arising, in this application, from the outward pressure of the circular motion of the water in the involute sluice and wheel.

The theoretic discharge of 230 square inches, under a pressure of 8·61 feet, is 2249 cubic feet per minute. The actual discharge is only ·498 of this. Had the discharge been outward, through the same aggregate aperture, and with the same circular motion of water, in the portion of the wheel occupied by the vanes, the discharge, (judging from the results of my experiments made in 1844,) would have been ·884 of theoretic discharge; and had it been outward, and *without* circular motion, it would have been about 1·289, at the speed of maximum power.

Z. PARKER.

Philadelphia, November, 1847.

The Chinese Magic Mirror.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

I notice, in your last number, an attempt to solve the mysterious phenomenon of the Chinese magic mirror: as that explanation seems to me erroneous, I am induced to offer another solution, which, if I am correct, can easily be verified by some of your ingenious readers. My attention was called to this curious piece of Chinese ingenuity by the intelligent proprietor of the Chinese Museum, in Boston, some time since. I examined it with attention, and found that the mirror consisted of a thin, flat plate of copper, with Chinese characters and figures on the back, projecting nearly the eighth of an inch from its surface; the face of the plate was silvered, and highly polished, and, on the closest inspection, no difference appeared on any part of the surface; the plate seemed to be of one casting, and the silver plating put on in the ordinary way, and equally polished. If this mirror was placed in the sun-light, so as to cast its reflexion on the wall, the characters that were raised on the back of the plate appeared in a brighter reflexion than the other parts of the mirror, which would seem to prove that those parts could not be made of a coarser metal. I therefore came to the conclusion that, in consequence of those parts over the characters being rigid, and the other parts elastic, a slight inequality of polish was produced on the different parts of the surface; so small, indeed, as not to be detected in any way but by testing its powers of reflexion.

J. J. Greenough.

Washington City, D. C., Nov. 30, 1847.

On the Theory of Dew.

We find, in the "*Annales de Chimie et de Physique,*" for October, 1847, two letters from M. Melloni to M. Arago, containing an account of some interesting experiments made by the former upon the production of dew, and the opinions and conclusions resulting from his researches relative to the subject. Not being able to afford space for the whole, we translate such portions as appear to us sufficient to explain the views of the author.

After the experiments of Wells, he thinks it might have been surely admitted, that dew neither rises from the earth nor falls from the sky, but is formed from an invisible and elastic fluid diffused throughout the space which surrounds bodies, and that the precipitation of this aqueous vapor should be attributed to the cold resulting from the calorific radiation of bodies towards the clear sky. According to this view, the leaves of vegetables, wood, glass, varnish, lampblack, &c., will be covered with dew, because they easily part with their heat and are considerably cooled when exposed to the sky: while the metals will remain dry, on account of their feeble power of radiation towards the upper regions of the atmosphere. If a polished metallic vessel, filled with boiling water, be presented to a thermoscopic apparatus—and afterwards one exactly similar, with its sides covered with varnish, or lampblack—the radiation of heat indicated in the latter case will be much greater than in the former. But however clear may be the deduction, it would seem that it has not been so considered by all. Indeed, Benedict Prevost, and Saussure before him, attributed the absence of dew upon metals to an electric influence: Leslie explained this phenomenon by a particular repulsion exercised by metallic surfaces upon aqueous vapor; and the supporters of the theory founded upon the supposed rising of dew, account for it by the heat and electricity disengaged in the chemical action of metals upon the molecules of this same vapor, at the moment of their passage into a liquid state.

In order to show that these different hypotheses could not be sustained, M. Melloni took three thermometers, graduated upon the stem, and passed each through a cork, which remained fixed at a distance of about a quarter of an inch from the bulb. This cork served as a support to the two parts of the metallic casing with which the thermometers were enveloped; the first being a little vessel of silver, or copper, very thin, similar to a thimble, with its surface smoothed and polished, of sufficient size to contain the bulb of the instrument; the other, a cylinder of tin, closed at one end and open at the other, used to cover the graduated tube of the thermometer. These two metallic pieces, which could be very easily removed and replaced, were readily kept in their proper positions by the friction and elasticity of the cork. Three tin vessels were then prepared, supported by slender metallic tubes, and having lids, or covers, of the same material; an opening being made in the side of each, near the bottom, into which were introduced the covered bulbs of the three thermometers, leaving the tubes and their envelopes horizontally disposed on the outside. The casing of one of the thermometers was blackened, and the others left in their bright state, with a view of comparing the nocturnal radiation of silver with that of lampblack. The whole was exposed to the free air in a calm and still night, the tin vessels being sometimes open and sometimes closed by their covers. When closed, the three thermometers indicated the same temperature; but on leaving one of the vessels containing one of the bright-cased thermometers closed, and opening the two others, the falling of the mercury in the bright-cased thermometer, thus opened to the sky, was so slow that it required a very delicate instrument and very exact comparisons to observe and measure its movement; while the blackened thermometer fell so rapidly as to be readily seen. and in a few minutes it marked three or four degrees less than the one in the closed vessel—thus proving, evidently, that this difference was due to the radiation, towards the sky, of caloric from the blackened instrument, and by no means to the contact of the exterior air, which acted equally upon it and upon the polished case of the other uncovered thermometer.

Thermoscopic apparatus, similar to those just described, having the cases covered with varnish, plumbago, fish glue, saw dust, sand, earth, and the leaves of plants, have constantly indicated a very sensible diminution of the temperature before being covered by dew. The interval has been sometimes for several hours; and there is often, also, an abatement of the temperature without the precipitation of vapor at any period of the night. The latter phenomenon occurs the more frequently as the thermometers are placed at a greater distance from the ground. Operating at a certain elevation, the deposit of dew upon bodies might, therefore, be suppressed, or retarded, and the fact be incontestably established that the formation of dew always follows, *and never precedes,* the production of cold. M. Melloni remarks that he has never seen the polished metallic cases of his thermometers covered by a condensation of aqueous vapor, in very damp nights, when there was no appearance of fog, or mist, in the atmosphere.

From all this, he concludes that dew, properly so called, always requires a certain cooling of the bodies upon which it is found; and that metals, exposed to a clear sky, are not covered with dew, because of their possessing the quality of being thus cooled but in a very slight degree. In order to determine whether other causes existed to prevent the accumulation of dew upon metals, and whether their feeble radiation is really the only and true cause of their being never covered with dew, he undertook the following experiment, the result of which he considers conclusive, and that it proves, at the same time, the falsity of the hypotheses of the rising and the falling of dew, as well as the truth of the principle asserted by Wells.

Upon a disk composed of a single plate of tin, as large and as thin as could be obtained, he drew a concentric circle with a radius equal to one-third of that of the disk, and covered it with a thick coat of varnish. From another plate of tin, he then cut a second disk, with a diameter about half an inch less than that of the varnished circle, and soldered to its centre, perpendicularly to the surface, the end of a piece of iron wire, ·08 of an inch in thickness, and eight or ten inches in length, pointed at the other end, which was inserted into a small hole made in the centre of the larger disk. Being inserted on the varnished side of the larger disk, the wire was pushed through until the distance between the two disks was reduced to about two-tenths of an inch, and then fastened in that position by a few drops of solder. The two plates, thus united, being taken, in a calm and clear evening, into an open field, and left in a horizontal position for a short time, removed from contact with other bodies, showed on the surface of the larger disk, phenomena of dew which may be readily anticipated.

The smaller disk being uppermost, and its radius being a quarter of an inch less than that of the varnished circle upon the larger disk below, it follows that an annular band of that circle, a quarter of an inch in breadth, extended around the vertical projection of the roof formed above it by the little metallic disk. Now it is apparent that this band would radiate towards the sky, lose a portion of its temperature, become covered with dew, and communicate, little by little, both cold and dew, consecutively, towards the centre and also towards the circumference. In the latter case, however, this propagation would be carried much further than in the former; for the portion cooled by communication would be further cooled by radiation when covered with dew—while the varnished portion, under the smaller disk, would be scarcely cooled except by contact. In effect, the central part of the varnished circle remained always dry, and the metallic zone which surrounded it became wet, even to the extremity, if the atmosphere was very moist.

But what could not, perhaps, have been anticipated at first, was the exact reproduction of the same appearances upon that side of the larger disk which was towards the ground. The dew began to show itself upon this side at points opposite to the little exterior ring of varnish, and a slight whitish circle was perceived, which, appearing all at once upon the blank field of polished metal, seemed like the formation of a Daguerrian image. This circle, becoming stronger and spreading by degrees, sometimes extended to the edge of the plate, but never reached the central part, which always remained dry and maintained its metallic brilliancy, like the corresponding portion on the other side of the disk, and the little circular roof, which covered without touching it.

This simple and easy experiment may be regarded as furnishing conclusive evidence upon several points connected with the theory of dew. It shows that dew does not fall from the sky—for the upper disk always remained dry, while the greater part of the lower one is moist. Neither does dew rise from the ground—for if a portion of the under side of the lower plate is covered with dew, there is always a space around the centre which remains dry and shining. The theory that metals repel the aqueous vapor which forms dew, or that they cause its evaporation as rapidly as it may be precipitated upon them, is disproved by the fact that we here see some parts of the metallic surfaces quite wet, while other parts remain perfectly dry.

The first appearance of dew upon the uncovered band of varnish, and its successive propagation to adjacent and opposite portions of the larger disk, associated with the increase of temperature developed by the varnished cases of thermometers exposed to the open air, prove, in short, that dew is a mere consequent of nocturnal radiation, which produces, in bodies endued with great emissive power, the degree of cold necessary for the condensation of the elastic aqueous vapor diffused in the atmosphere.

In his second letter, M. Melloni proceeds to show that, if the principle of Wells concerning the origin of dew were established beyond doubt, it would still be impossible to account for all the thermometric and hygrometric phenomena which are produced during a clear and still night, without taking into consideration a new circumstance, until now entirely neglected, notwithstanding its exceeding importance in the nocturnal cooling of bodies. But before proceeding to give an account of this, M. Melloni makes some observations upon two series of experiments which the supporters of the theory that dew rises from the earth have put forward with the pretension that these alone are sufficient to overturn all theories of dew founded upon the principle of calorific radiation.

They took a certain number of thermometers, as nearly equal as possible in volume and in sensibility; some of which were coated with lampblack, varnish, Indian ink; others gilded, silvered, covered with leaves of plants, tin, copper, &c. These instruments, thus prepared, being exposed in the fields during a clear and still night, at first indicated temperatures with some little difference; but after a certain space of time they were found to agree very nearly. The experiment was then varied in the following manner. Cylinders of glass were planted in the ground, on the tops of which were placed plates of zinc, copper, and glass, in each of which was made an opening to receive the bulb of a thermometer, whose tube, supported by an iron wire, was elevated above the upper surface. A thermometer was freely suspended between the plates, for the purpose of showing the temperature of the air. In this case, as in the other, the apparatus being exposed early at night, indicated differences of temperature which afterwards disappeared, insomuch that by daybreak next morning all the thermometers were found at nearly an equal height.

The opponents of the principle established by Wells, regarded these results as decisive, and they consequently stigmatized the principle that the nocturnal cold of bodies is indispensable in the formation of dew, as a mere chimerical illusion. M. Melloni, on the contrary, thinks that if there is anything imaginary, or fantastic, in the matter, it is in the reasoning which led to such a conclusion; inasmuch as the experiments of these gentlemen were made near the ground, in an atmosphere charged with moisture—all the tubes of the thermometers being uncovered—and in the last experiment the bulbs communicated, by means of the plates, with the cylinders which served to support the apparatus. Now the glass of which these tubes and cylinders were composed radiated considerably, its temperature was reduced, and the cold acquired was communicated to the bodies which touched it; these, being surrounded by a very moist atmosphere, then condensed the aqueous vapor; and we know that water radiates and cools itself with as much energy as glass, varnish, and lampblack. It is not, therefore, surprising that the thermometers in contact with the sheets, or plates, of metal, should indicate, after some time, the same temperature as the thermometers surrounded by substances which radiate most; and because the metallic surfaces, *which were found to be covered with dew,* were as cold as the glassy, or the blackened, surfaces, it might well follow that water, glass, and lampblack, are substances of nearly equal emissive power. But without a resort to poetic fiction, it would never be logically inferred, from this experiment, that metals are cooled, during calm and clear nights, as much as lampblack and glass.

In order, therefore, to understand the true condition of things, glass should not be used for the supports, but slender tubes of tin, which have scarcely any radiation, and maintain the thermometers sufficiently isolated from the warmth of the ground; it is necessary, moreover, to enclose every part of the thermometer with metallic laminæ. Then, these laminæ being polished, the thermometer will give a temperature very nearly approximate to that of the air, and when the metallic enclosure is varnished, blackened, or in contact with vegetable leaves, or any other substance, we can ascertain, by a simple comparison with the bright thermometer, the degree of cold produced by the radiation of this substance. By means of instruments thus prepared, M. Melloni has assured himself that the leaves of plants, glass, varnish, and lampblack, are always cooled in clear and still nights, from one to two degrees (Centigrade*) below the temperature of the surrounding air.

In observing the small amount of this cooling, it might seem that the decrease of temperature of seven or eight degrees, reported by Wilson and Wells, was a great exaggeration. But considering that the differences obtained by these gentlemen contained an element foreign to the question, that the thermometers used to obtain the ambient temperature were elevated four or five feet, while the instruments enclosed by the radiating substance were very near the ground, it is easy to understand the reason why there is so great a difference between the results obtained by them and those of the writer.

M. Melloni then refers to the experiments of Peclet, which showed, long ago, that the temperature of the air, in calm and clear nights, decreases rapidly as we approach the surface of the earth. He observes that the simple fact of this decrease ought to render the temperature of a radiating substance, placed near the ground, inferior to that of the air surrounding a thermometer elevated four or five feet; so that, in this arrangement, the difference of the two instruments by no means shows the desired result, namely, the cooling of the body below the temperature of the ambient medium.

There is, however, one experiment of Wells, in which a thermometer, wrapped in wool, being placed on the same level with a free thermometer, showed a decrease of temperature amounting to 5·3 degrees. Here, the wool was cooled to a degree two or three times greater than the lampblack used in the experiments of M. Melloni, who remarks that he knows, notwithstanding, that the emissive power of wool is not greater than that of lampblack. In order to investigate the cause of this extraordinary discrepancy, M. Melloni enveloped the coating of one of his thermometers with wool, and exposed it to the air with two others of the same size, one of which was covered with lampblack, and the other retaining its metallic brightness. In a few minutes the descent in the instrument wrapped in wool was twice as great as that in the blackened thermometer. A fourth instrument was then enveloped in an equal quantity of wool, which was closely pressed and confined around the metallic casing by means of a thread of the same material: this showed a cooling intermediate between the two former indications. He next enveloped a fifth thermometer with a double coat of fine flannel, which fell still less than the fourth. The experiments were repeated by substituting cotton for wool, and results altogether analogous were obtained. I then comprehended, says M. Melloni, that the superiority of cotton and wool over lampblack, in the phenomena of nocturnal cooling, was due to a certain modification effected in the emissive power of these bodies by the presence of the air contained within their interstices.

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* A degree of the Centigrade thermometer, which is used by the French philosophers, is equal to one and four-fifths degree of Fahrenheit.

The agency of air in thus augmenting the cold produced by radiation, he explains as follows: It has been known, for a number of years, that the nocturnal cooling of bodies does not vary with the temperature of the atmosphere. Thus, Captains Parry and Scoresby found that, during calm and clear nights, in the polar regions, the snow cooled about nine degrees below the stratum of air at four or five feet high, when the atmosphere was at 25 or 30 degrees below 0, and the same when the temperature was very near 0. M. Pouillet has seen the down of the swan fall about seven degrees in temperature at 0, and at 2·5°. And, on his own part, M. Melloni assures us that the fall in his blackened, or varnished, thermometers is a constant quantity, whatever may be the temperature of the night. Now it may be conceived that the tufts of cotton, or wool, spread over the upper part of the thermometric bulbs under the action of a clear sky, after being cooled by radiation, would communicate the cold thus acquired to the surrounding air, which, becoming heavier, descends within, and falls towards, the ground; but there is always required, by this condensed air, a certain time for its disengagement from the obstacles which arrest it among the threads. These are, then, surrounded by an air colder than it was at the commencement of the experiment; and as *their decrease of temperature below the ambient medium must continue invariable*, it necessarily follows that they must cool still further. This increase of cold will produce a further decrease of temperature in the medium; the fall of temperature in the medium will react by still further cooling the radiating body, and so on, continually, until the weight acquired by the condensed air delivers it from the obstacles which opposed its passage from the enveloping substance.

This process, which takes place when tufts of cotton, or wool, are artificially placed around thermometers, must occur naturally under many circumstances. Thus plants which have downy leaves are colder than those whose leaves are smooth and glossy. The temperature of grass, and other low plants, which cover the fields, falls, by reason of this frigorific reaction of the air, considerably below those of more elevated growth, on account of the immediate proximity of the earth, which sustains the ambient medium and compels it to remain about the radiating surfaces. In fact, the stratum of air which envelopes the grass of a meadow is not maintained at rest; but, on the contrary, is subjected to agitation similar to that of water in a vessel placed over the fire: the particles condensed by the cold of the pointed leaves of grass descend to the ground, are warmed by contact with the earth, ascend again among the herbage, and so on, continually. But it is evident that, notwithstanding this state of agitation, the temperature must be finally decreased; and that the grass, to be kept continually cooler than the air by a constant ratio, must itself become cooler and cooler, which will produce a gradual reduction of temperature and an increasing humidity in the stratum of air.

M. Melloni concludes his second letter by announcing that he will shortly submit to the Academy a memoir, in which he will treat of a number of interesting and important questions connected with the nocturnal reduction of temperature, and the production of dew.

In the "*Comptes Rendus*," for October 11, 1847, is a third letter from Melloni to Arago, complaining that certain journals had misrepresented his views as expressed in the former letters, and making further remarks upon the subject under discussion. This letter we translate as follows:—

My studies upon dew seem to me to have placed beyond doubt this fact, that if the principle of Wells is true, the theory which goes by that name is erroneous, or, at least, altogether incomplete. I thought I had so clearly defined this proposition that no mistake could arise; but in looking over several periodical publications, I find that it has been altogether distorted. In effect, the conductors of these journals adopting, perhaps, the opinion of him among them who first gave an account of it, cite the first part of my theorem and say nothing of the second; the reader is thus led to believe that my labors tend solely to confirm the theory of Wells, such as it is developed in all the physical and meteorological treatises; though my experiments lead to a directly opposite conclusion. I shall endeavor to make myself better understood, starting from the data themselves which form the basis of this theory.

Let us suppose two pairs of thermometers, enclosed in their metallic cases, and suspended by means of thread, or metallic supporters, according to the method described in my first letter. Suppose each of these pairs to be composed of one thermometer with a bright case, and another blackened. And suppose, finally, that during a still and clear night, one of these pairs should be fixed very near the grass in an open meadow, and the other at four or five feet high, so that the two thermometers of each pair shall be at the same level.

After being exposed thus for a few moments, the blackened thermometers will be seen to descend about 1·5° (Centigrade) below the metallic thermometers placed by the side of them. The temperatures, however, indicated by the lower couple will be very different from the temperatures marked by the higher two; this difference will reach to five or six degrees in calm and clear weather; and as the lowest indications will always be shown by the pair lowest in position, we infer from this that the differences observed between the indications of the two pairs of instruments, proceed solely from the unequal temperatures of the different atmospheric strata in which they are placed, and that consequently, during calm and serene nights, the temperature of the air decreases rapidly as we approach the surface of the ground.

Now the experiment upon which the theory of Wells is founded, consists in the often repeated observation that a common thermometer, placed in contact with the grass, indicates a considerably lower temperature than one elevated four or five feet from the ground; from which it has been concluded that the grass was cooled several degrees, by radiating towards the sky. But it is easy to satisfy one's self that this deduction is by no means correct. Place the glass bulb of one of your thermometers in contact with the grass, and hold the other freely suspended in the air, at the same distance from the ground, and you will find that the two instruments mark the same degree. Now no one will deny that this is not the way we should operate, to demonstrate, according to the old method, the reduced temperature of the grass below that of the surrounding medium. We are, therefore, compelled to admit that the fundamental data of the theory of Wells are inconclusive:—1st, Because the surfaces of the thermometers used have as much radiation as the leaves of the grass. 2nd, Because the thermometer intended to measure the temperature of the air was placed in an atmospheric stratum much warmer than that which surrounded the vegetable leaves placed in contact with the other thermometer.

The principle of the formation of dew, in consequence of the cold produced by the radiation of bodies is, I repeat, entirely just, and the theory of Wells inaccurate. The cause of this inaccuracy is evidently in consequence of having entirely neglected to consider the influence of the air in the production of the cold which is successively developed near the surface of the earth. It has, indeed, been said, vaguely enough, that radiating bodies, situated at a certain height, will not have their temperature lowered as much as those placed near the ground, on account of the descending currents which are formed around the former, and cannot exist around the latter. But that is insufficient to show the real agency which the air has in the formation of dew.

It was necessary to demonstrate, as I believe myself to be the first who has done, that, notwithstanding its incapacity of cooling by radiation, the air which rests very near the earth contributes greatly to lower the temperature of plants surrounded by it, by means of a series of actions and reactions, of which the cause and the effects are clearly defined, if I mistake not, in the second of the two letters which form the subject of this discussion. You, who have perfectly comprehended their true meaning, will doubtless permit me to spare you the fatigue of a useless repetition, and to recommend to the conductors of the journals just mentioned, a somewhat more attentive perusal of the numbers of the *Comptes Rendus*, in which they were inserted. After which they shall have full and entire liberty to prove that I am wrong; but they will first admit, at least I hope so, that they have wrongly informed their readers with regard to the consequences resulting from my investigations of the phenomenon of dew.

New Mode of Making Artificial Magnets.

Sir,—As magnetism is now applied to many purposes of practical utility, as well as in many instructive and amusing experiments, and as artificial magnets can easily be made of greater power than loadstones, I presume it will be acceptable to many of your readers to know how artificial magnets may be made without any risk of failure.

Makers of magnets and compass needles know that if the most careful and skilful workman be employed in preparing a number of magnets from the same steel bar, the magnetic power of the magnets, when compared with each other, will greatly vary; although every possible care may be taken in forging, tempering, and magnetising, in a uniform way. Experience in these matters convinced me that discrepancies in the magnetic powers of magnets of the same length, weight, and quality of steel, arise from the *tempering alone;* for if the metal be heated in a furnace, or coal fire, one part of the bar may be in contact with glowing coal, another part in flame, a third in heated air, a fourth in contact with coal in a state of ignition, &c.; consequently, the metal is not in all its parts raised to the *same* temperature, when suddenly removed from the fire and plunged into a cooling fluid. The relation between the degrees of heat in the heating and cooling mediums is absolutely unknown; magnets tempered in this uncertain way will possess different degrees of hardness throughout their length, and their capacity for magnetism in all their particles will be unequal and uncertain.

Reasoning in this way, it appeared to me, that in order to make compass-needles and steel magnets successfully, we require *specific heats* in the *warming* as well as in the *cooling* process of tempering; in order to insure the same degree of hardness throughout the steel bars; that is to say, that the metal when cold should be a homogeneous mass, and possess a uniform capacity for the reception and retention of the magnetic virtue.

Metalurgists know that lead melts at a low temperature, but if left on a good fire, it gets first a red, and then a white heat; that continuing to absorb caloric, it ultimately *boils* at a uniform heat, which melts gold or silver, as is evident in the process of "cupelation." Now here we have a *specific* heat at probably 5000°, and we have also a specific heat of boiling water at 212°. It therefore struck me that by heating my needles in boiling lead, and cooling them in boiling water, every particle of the steel would be first raised to, and then cooled down to the same temperature and degree of hardness. The experiments have been made with complete success; and more powerful magnets have been made in this way than were ever made before, *without risk of failure.*

Magnets weighing 600 grains, and 6 inches in length, have held in suspension 14 times their own weight; and compass-needles have given by deflection 30°, at twice their length, from a test-needle. I find that magnets tempered in this way are not liable to break, but possess with great hardness a *toughness*, derived probably from the boiling water. Their power of retaining the magnetic energy has *for four years* remained unimpaired, although left without "keepers."

To manufacturers of magnets and makers of compass-needles, a knowledge of this mode of tempering steel, at a specific temperature of the heating and cooling mediums, will enable them to make articles of a superior quality without risk of failure, or needless expense; and as I have no other object in view than the advancement of useful knowledge, I now send you these remarks for publication.

In heating the steel, the bars require to be pressed under the surface of the boiling lead (as the steel would otherwise float on its surface), and the magnet should be suddenly shifted from the lead to the boiling water, the instant it has acquired the temperature of the boiling lead; for to leave it longer in the lead would spoil the smooth surface of the steel, and render it as rough as if heated in a furnace or common fire.

I am, Sir, yours, &c.,

WILLIAM WALKER, *Q. H. Master.*

Plymouth, October 12, 1847.

Lond. Mec. Mag.

Specification of a Patent granted to PATRICK MOIR CRANE, *of Yniscedwyn Iron Works, near Swansea, Iron Master, for Improvements in the Manufacture of Iron.*—[Sealed, April 8th, 1847.]

This invention relates to an improvement in that part of the manufacture of malleable iron where what is called refinery iron is produced, by melting pig-iron in a refinery furnace; and it consists in a mode of employing anthracite or stone-coal in the process of making refinery iron. The patentee says he is aware that this has been before attempted, but without success, on account of the peculiar character of the anthracite or stone-coal, which is liable to decrepitate and fly off into dust on sudden exposure to heat; now, the present invention consists in subjecting the anthracite or stone-coal to heat, before introducing it into the refinery furnace. The preparatory heating may be effected in any convenient way: and the coal may be used either in an ignited or highly-heated state, or in a cold state (having been first ignited or highly-heated). After such preparation, the coal will bear either the hot or cold blast; and whichever blast be used, the patentee prefers that it should be introduced through two or more small tuyeres, instead of one large one. The refining process is conducted in the same manner as when coke or charcoal is used. In the manufacture of pig-iron by the aid of anthracite coal in the blast furnace, a considerable quantity of highly-heated anthracite coal comes from the furnace in lumps, in that process commonly termed by the workmen "throwing off;" and the patentee either introduces these lumps in a heated state into the refinery furnace, or he preserves them for future use. Or, instead of employing these lumps, the patentee causes the raw anthracite coal to be ignited in masses in pits, kilns, or ovens, and, when thoroughly ignited and heated, he carries it direct to the refinery furnace, or preserves it for future use. Although the patentee has used the anthracite coal alone, other fuel may be employed therewith.

The advantages said to result from the use of anthracite coal, according to this invention, are,—that a considerable saving is effected in comparison with the coke of bituminous coal—the cinder contains less iron than that from a refinery furnace worked with the coke of bituminous coal—and in those districts where anthracite or stone-coal can alone be obtained, manufacturers of iron will now be able to refine their iron, which has not hitherto been the case.

The patentee claims, as his invention, "applying, in the manufacture of refinery iron, anthracite or stone-coal, which has been ignited or raised to a high temperature, before introducing it into the refinery furnace."—*Inrolled, October,* 1847.

Lond. Journ. Arts & Sci.

Manufacture of Alkali and Chlorine.

Mr. C. T. Dunlop, of Glasgow, has recently obtained a patent for some "improvements in the manufacture of alkali and chlorine, and in the application of the product resulting therefrom;" the first part of which consists in an improved method of producing chlorine, fit for manufacturing purposes, by the mutual decomposition of the following substances:—Muriate of soda, or any other muriate—nitrate of soda, or any other nitrate—muriatic acid—nitric acid. In some instances it is also requisite to use sulphuric acid; and the patentee generally prefers to employ it, in order to obtain, as a residual product, sulphate of soda, suitable for the manufacture of soda, &c. All the above materials may be employed together, or only two of them; as, for instance, a nitrate with a muriate (in which case sulphuric acid must also be used), or a muriate with nitric acid, or a nitrate with muriatic acid, or muriatic acid with nitric acid; in the latter cases, sulphuric acid is employed, according to the results desired to be obtained. The patentee says—he does not confine himself to any proportions, but the process he usually adopts is, to bring together common salt, nitrate of soda or nitric acid, and sulphuric acid, in suitable proportions; heat being then applied, chlorine, an oxide of azote, and muriatic acid, are evolved; these gases are caused to pass through a condenser, charged with sulphuric acid, of sufficient strength to absorb the oxide of azote; and then the chlorine and muriatic acid are separated by means of water. The second part of the invention relates to the application of the product resulting from the above process, and consists in the production of nitric acid from the sulphuric acid, charged with oxide of azote, which is true nitrous sulphuric acid. This is effected by the aid of atmospheric air, steam, and water; and the process adopted by the patentee is, to introduce the nitrous sulphuric acid into a suitable vessel, and, by the addition of water and heat, to effect the disengagement of the oxide of azote, which, being caused to traverse a condenser, together with a sufficient quantity of air and steam, or water, is by this means transformed into nitric acid: this acid may be again used in the manufacture of chlorine, and again recovered, and so on. Sometimes, in place of treating the nitrous sulphuric acid, as just described, the patentee causes the oxide of azote to be evolved, and to pass into a chamber, into which a current of sulphuretted hydrogen is streaming; by which means sulphate of ammonia is obtained and sulphur deposited. The patentee claims the manufacture of chlorine from the materials above mentioned, in the manner described; the process employed for separating the gaseous products, so as to obtain the chlorine in a sufficiently pure state for manufacturing purposes; and the two processes described for utilizing the products resulting from the manufacture of chlorine. Lond. Min. Journ.

Improvements in Casting Cylindrical Pipes.

Mr. D. Y. Stewart, of Montrose, has taken out a patent for a new mode of casting iron, water, or gas pipes, or other cylindrical tubes; by which a far more superior material is produced, at a much less cost than by the usual method. The mould consists of a perpendicular cylindrical iron box, of the required size, with a shaft in the centre, longer than the mould, and communicating with machinery above, by which it is kept revolving, and, as it revolves, it gradually rises. At the bottom of this shaft is an instrument. which may be termed a "presser," or "rammer," consisting of an iron block, having inclined tabular faces, of such smaller diameter than the box, as to leave the sand of the required thickness for the mould. On feeding the sand at the top of the box, it is distributed towards the sides, and the shaft and rammer, gradually revolving and rising, press it with great force against the side of the box, leaving the mould finished and perfectly cylindrical on its arriving at the top, ready for the insertion of the core. The amount of pressure against the sand is regulated by means of a counterpoise weight. The following are the advantages claimed by the patentee:—" 1. A perfectly straight cylindrical pipe, of uniform thickness.—2. No parting or joint of any kind.—3. Dressed at one-half the ordinary cost.—4. Less sand used than in any other way, and, of course, easier dried, if required.—5. The castings and sand easier removed from the boxes than in the ordinary way.—6. The flasks, or boxes, better calculated to resist the pressure of the metal than any now in use.—7. This method is the best for casting pipes perpendicularly that has hitherto been employed.—8. The greatest recommendation of all is, the simplicity of the apparatus, which requires the attendance of a boy only, who with my machine, as at present working, turns out easily six pipes, six inches bore, per hour." We understand that two miles of water-pipes have been laid by the patentee at Montrose, and the Town-Council passed him a vote of thanks. Some capitalists have joined the patentee, forming a company, and ground has been secured in Glasgow, where premises will be erected for carrying on the business on a large scale.

Lond. Min. Journ.

On a New Process of Engraving, called Stylography.

A new method of engraving has been invented by M. Schœler, a native of Denmark. In 1842, M. Schœler had so far perfected his invention as to produce satisfactory results, which were submitted to the King of Denmark, who rewarded the invention on the condition of his publishing a complete description of his method. In conformity with this agreement, he has just published the particulars of the process at Copenhagen, and has also made it known at Bruxelles. The Academy of Sciences of this latter city approved of it in its sitting of the 4th December, 1846. M. Buschman d'Aurey subsequently made use of it at Antwerp, and, on the 18th of last May, his experiments were submitted to the Academy at Bruxelles.

One part of copal, three of stearine, and three of lac are melted together, and a sufficient quantity of Frankfort black is added to render the composition black. The whole is melted in a mould about six lines (or half an inch) in depth, formed of two sheets of copper, which are first rubbed over with an amalgam of tin, and whiting and Tripoli, blackened over the flame of a lamp. The sheet of composition is then to be taken from the mould; it will come out easily, and will harden on contact with the air. It is afterwards to be rubbed with a solution of resin in spirits of wine, and polished; and before it is quite dry it is to be covered with silver powder, until it is like a sheet of white paper. The design is then to be counter drawn on it in red, and the whole is to be gone over with a dry-point or graver, the different shades being regulated by cutting to greater or less depths, and varying the width of the lines as well as the distances between them.

The design being engraved, it is to be cleansed with water, and covered with a solution of sugar mixed with a small quantity of nitrate of silver, and bronze powder laid on with a brush.

It then only remains to apply the known processes of galvanoplastics: first, a plate is formed in relief, and from that the plate is produced which is to be printed from, in the same manner as etched or engraved plates. The principal advantage of M. Schœler's process is a saving of labor to the engraver, as he draws in black on a white ground, in the same manner as with pencil and paper.

The results hitherto obtained, although satisfactory, must be merely regarded as slight indications of what may be done by this process in the hands of skilful artists, when some apparent difficulties incident to all new industrial processes (such as lithography, for instance) shall have been made to disappear by practical experience.

If, however, M. Schœler's process does away with some disadvantages which are frequently encountered in the ordinary process of etching, and which are unfavorable to the production of good engravings, it necessitates an extra operation (that of electrotyping) which occasions a certain expenditure of time and money; but it is not unreasonable to suppose that by experience some improvement will be effected in this part of the process. It is not likely that *Stylography* will ever rival line-engraving in beauty; but it possesses over it the advantage of not requiring for its execution one-tenth part of the time: and, moreover, by this means the artist may himself engrave his design with even greater facility than it could be lithographed; which is a great advantage, when he wishes to produce a great number of copies of his work.

M. Schœler has sent thirteen specimens of his works to the Royal Academy at Bruxelles, consisting of two landscapes, three studies of heads, portraits of Frederick VI. and Beethoven, portraits of Lord Byron at several periods of his life, and five finished studies of heads, amongst which, an oriental study, about four inches high, is a very excellent specimen, as the finest and most delicate lines, produced by the point, are well brought out. Several of these specimens have the fault of too much vigor, or rather perhaps too much hardness and dryness; a very skilful hand being required to handle the point lightly, and to produce effective shadowing; but this is easily acquired by artists, as will be seen from the perfection which has been arrived at in lithography.—*Bulletin de la Societé d'Encouragement.*

Lond. Journ. Arts & Sci.

Extracts from Proceedings of Cornish Scientific Meetings.

Apparatus for ascertaining the specific gravities of bodies expeditiously.—This was invented by Mr. R. W. Fox, who said that, in visiting Wales a month or two ago, it appeared to him that it would be important for the iron smelters there (buying as they do Cornish and other kinds of ore), to have some apparatus for easily ascertaining the specific gravity of ores, that having reference to their richness. He had since then constructed a little apparatus for weighing quantities. The principle depends upon the weight of water displaced, as indicated by an external graduated tube, the amount of the displacement being the divisor of a body weighed in air. The apparatus is also capable of acting as a balance by the use of a close cylinder, which by sinking in the water raises the water in a tube carefully graduated ; so that, when the water is brought to the zero point, every substance put into the cylinder of any kind, and however divided, will have its weight indicated in the tube. The apparatus is applicable to weighing ores of all kinds, and to detecting the presence of any metallic substance in stony matter. For instance, he knew the specific gravity of quartz or slate, and, if it exceeded that, he should suspect there was some metallic matter in the stone, and the weight would show the amount of metallic matter. He believed it would ascertain the specific gravity to the third figure of decimals. The adjustment of the zero is easily accomplished by a little cock below the tubes, and the construction of the apparatus is very inexpensive.—Mr. Fox, in giving a further account of this instrument on the following day, said he could weigh substances, whether iron, manganese, tin, or any kind of ore, of which he wished to obtain the specific gravity, that having always reference to its richness. He might first weigh it in a common balance, or he had the means of weighing it by the water balance in the instrument itself. After stating the manner in which he had carefully graduated the scale, he weighed some quartz pebbles by means of the instrument, which amounted to 2560 grains—this being the same, he stated, as if they had been weighed in a common balance. He next weighed the same pebbles in water, the difference between that and the weight in air giving the specific gravity. The weight in water was 1050 grains, which being used as a division of the weight in air, 2560 grains, gave the specific gravity as 2·438, or nearly two and a half heavier than water. The instrument, he said, was capable of testing the weight, as compared with water, of any earthy substance, of soils, or of any lighter substances than water, by pressing them down. He thought that, for testing the specific gravity of tin, iron, or manganese ores, the utility of the instrument to miners may be very considerable.—Mr. John Taylor spoke of the benefit that must result from the use of such an instrument as that invented by Mr.

Fox. Supposing, for instance, that lead ore was mixed with quartz, this instrument would afford a ready way of determining the amount of metallic substance in such ore. A large quantity of iron ore was now exported from this country, which ore was very homogeneous in its metallic character, and might be determined by the ascertained specific gravity of any sample. It was very desirable to have a ready way of finding this specific gravity, and he considered that Mr. Fox's instrument was well deserving the attention of his brother miners.—The President expressed his delight to hear that the Cornish iron mines were more productive than they had been in time past.

Improved Counter, or Plegometer.—This machine, the invention of Mr. E. T. Newton, of Camborne, was thus described:—This counter is intended to register the exact space passed through by the piston of a pumping engine. On the examination of this instrument, when attached to the engine, it will be found that the slightest movement of the piston (when making the stroke) is shown in a proportionate degree on the index, and that on the return of the same it stands still, so that every inch traversed is accurately shown. The cause of difference in this and the old counter arises from the falling of the pendulum when the engine has gone about three-fourths of her stroke, and even should she stop here, the latter tells the full stroke; whereas, *Newton's Improved Counter* registers only the *exact* space passed through by the piston. From the simplicity of its construction, it is not so liable to get out of order as those heretofore exhibited, being free from clicks and the ratchet, which have been found not to answer. This instrument is attached to the gudgeon of the bob by a shaft, or rod, on the extreme end of which is a lever, with a connecting rod to a second lever, so constructed as to be adjusted to any length of stroke; under the instrument is fixed a friction-wheel, composed of a mixture of zinc and lead, with grooves on its edge; into these are fitted two springs attached to the lever, and two others of the same kind fixed directly opposite; so that when the lever is being lifted by the motion of the bob, the springs attached thereto act by pressure, whilst the others yield, and on return of the stroke they act *vice versa.* It will be seen, from the report of Mr. Lean, that this counter has been applied to the engine at North Roskear Mine for six months, ending Aug. 25, 1847, and the result shows an average loss of seven inches per stroke, and 3·3 millions on the duty of the engine per month, during that period.

Machine for Registering the Variation in the Velocity of Pistons.—This machine was described as follows:—It consists of a cylinder (on the circumference of which is placed the paper on which the observation is to be taken), driven by a connexion being made with any convenient part of the beam, and an arrangement of a crank and levers, or other suitable means for producing the regular reciprocating motion of an arm carrying a pencil at its extremity, resting on the circumference of the cylinder. In the model, there was a narrow cylinder attached by a pinion and wheel, for its more convenient adaptation to engines having a long stroke. When the piston is at rest, the pencil will describe a straight line across the paper, extended for its reception; the latter being set in motion by the revolution of the cylinder, a series of curves varying according to its velocity will result. By dividing these curves longitudinally into any number of equal parts, the velocity of the piston during any part of its stroke may be easily obtained. The inventor stated that the observations may be preserved, and the results obtained at any period from the time of observation with mathematical precision. Other means, he stated, for producing the reciprocating motion of the pencil may be adopted with advantage, that made use of being not quite so uniform as it should be—a circumstance referable to inexperience, and a want of time for its rectification.

New Application of Magnetism.—It was proposed by Mr. James Way, of Burncoose, to apply the magnet, not at once as a motive power, but to the economy of power obtained through other agencies—and this by employing it to lessen the friction of rotatory or oscillating bodies. In the model illustrating this proposition, a permanent magnet is fixed over the vertical axle of a wheel—the axle being of iron, and the magnet so nearly in contact with the surface of the upper end of the axle that the weight of the wheel is nearly, but not completely, balanced by the magnetic attraction. On giving motion to the wheel by the descent of a weight, it will be found that the momentum acquired is sufficient to keep the wheel in rotation for a definite period, and that this period is considerably greater when one of the poles of the magnet is brought in close proximity to the end of the axle, than when so far distant that the axle is beyond the influence of the current. The writer has found, from repeated experiments, that when the magnet is effectively placed, the descent of the weight causes the wheel to continue revolving during 30 seconds, whilst on its removal this period is reduced to 20 seconds. In other words, the amount of power *gained* or economised, and capable of useful application, is in the case of the model exhibited, not less than 50 per cent. on the whole of the power which would be of service were the magnet dispensed with. The friction of rotating bodies being (as shown by Couloumb) in direct proportion to their weight or pressure on their centres, the writer submits that a magnet of suitable power may be so placed over the axis of a wheel, revolving either vertically or horizontally, as to reduce the friction to a minute fraction of its original amount, this remaining fraction being due to the necessity which would exist in practice for allowing the weight of the wheel to preponderate slightly over the lifting tendency of the magnet. Although probably incapable of being economically applied to massive machinery, it is believed that in increasing the delicacy of chronometers, of balances, and even of the magnetic needle itself (in the mariner's compass), and of all the lighter forms of mechanism in which friction is a formidable evil, the employment of permanent magnets as anti-friction agents might be successfully resorted to; whilst electro-magnetism, giving the command of weapons vastly more powerful, might even be available in the case of larger rotating or oscillating machinery.

Lond. Min. Journ.

Specification of a Patent granted to John Robert Johnson, *Nelson Square, Surrey, for Improvements in Purifying Gas, and in the Treatment of Products of Gas Works.*

This invention consists, first, in a new mode of purifying gas (used for the purpose of illumination) from those impurities which consist of ammonia and its compounds. Ammonia exists in gas after it has passed the condensers and before entering the lime purifier, in combination with several volatile acids, for example, the hydrosulphuric, hydrocyanic or prussic, and carbonic acid. When the gas has passed the lime purifier, these compounds have become decomposed, the lime combining with the acids before mentioned, and liberating the ammonia, which is then found in the gas in the uncombined or so called caustic state. Various plans have been proposed to effect the separation of the ammoniacal compounds. Dilute acids have been employed, and likewise solutions of metallic salts, such as the chloride of manganese. These plans have, however, the disadvantage of requiring a considerable increase of pressure to force the gas through the fluid; and the use of motive power is sometimes required to render the operation successful. To obviate these inconveniencies, and to effect the separation of the ammonia, the patentee employs substances possessing the property of absorbing ammonia or its compounds in the dry or, more properly speaking, solid state, instead of in the state of solution, as has been hitherto practised. All the fluid substances which possess the property of absorbing ammonia and its compounds have, as far as the patentee's experiments extended, been found to possess the same property when employed in the solid state, provided they were used in a divided or pulverulent form, and that they contain sufficient water of crystalization or hygrometric moisture to bring the gas and solid matter within the sphere of affinity. The substances which possess this property may be divided into two classes:—First, those which act on the compounds of ammonia in the manner of the acids, that is to say, which absorb the ammonia only, and which liberate, or only partially absorb, the acids with which it was previously in combination. Among this class of substances are comprised the solid acids, such as the phosphoric, boracic, and other acids; the salts with excess of acid, as the bisulphates of potash, of soda, and of ammonia; the biphosphates of these bases, and other salts of this class; the salts of alumina and of some other earths. Second, those substances which absorb the compounds of ammonia entirely, acid as well as base, entering into combination with the components of the substance used; the metallic salts, containing the requisite quantity of water, are comprised in this class, and will serve more or less perfectly for the purpose required; but the salts of iron and manganese, from their cheapness, will be found preferable to others.

The mode which the patentee adopts for carrying out this part of his invention is as follows:—He takes, for example, one of the substances included in the second class, viz., the sulphate of iron or common green copperas of commerce (as usually found in commerce it is in the state of crystals, dry to the touch, but containing a large quantity of combined water, or water of crystalization), and this salt he reduces to powder, in the ordinary way. The finer the powder, the more complete will be the decomposition of the salt by the ammoniacal compounds. This powder is employed in precisely the same manner as the moistened lime is used in what are called dry lime purifiers; that is to say, it is spread upon the shelves of a purifier, constructed like that used for the dry lime only; and the subsequent part of the process is the same as with dry lime, the cover being lowered and sealed, and the gas allowed to pass until the application of a piece of turmeric, or other test-paper, shows that the material ceases to absorb the ammonia. When this point is arrived at, the gas is turned into another purifier, similarly prepared, and the one just saturated is emptied. It should be remarked that, although but one purifying vessel is mentioned as being used at a time, yet the operation is more perfectly effected when a series is employed, as in the lime purifiers, and is as well understood. The purifier, or series of purifiers, containing the substance used for absorbing the ammonia, is preferred to be placed so as to receive the gas before it enters the lime purifiers, as the acids in combination with the ammonia are then absorbed by the substance, (when belonging to class second,) the quantity of time required for the purification of the gas is diminished, and the union of one of these acids (the hydrocyanic) with the salt of iron gives rise to a useful product. When employed subsequently to the passage through the lime purifiers, one of the substances of class one will be found most advantageous.

The patentee finds the water of crystalization in sulphate of iron is sufficient to bring the salt into a fit state to effect the absorption of the ammoniacal compounds; but he does not confine himself to the use of salts in their natural state; for the salts may have a certain quantity, more or less, according to their nature, of water added, beyond that which they naturally contain; the powdered sulphate of iron, for instance, if slightly moistened, so that it hangs together, acts equally, as in the former case, and rests better upon the shelves of the purifier.

The second part of the invention consists in a new mode of treating the ammoniacal liquor of the gas-works, for the purpose of preparing the salts of ammonia in a purer state than they have been usually obtained, and without the noxious exhalations which attend the ordinary mode of operating. In treating the ammoniacal liquors by the ordinary process, a large quantity of highly offensive and deleterious gas (sulphuret of hydrogen) is evolved; and, to remedy this inconvenience, it has been proposed to distil the liquor, mixed with a large quantity of lime, condensing the vapors and passing the products of condensation into an acid. Another plan is, to evaporate the liquor with or without lime, and to pass the vapors through acid without condensation. In the former case, in carrying the operation into practice on a large scale, it was found that deposits of lime were obtained, and that the process was thereby rendered dangerous and otherwise objectionable. According to the second plan, unless lime be used in the evaporation, the operation is unsuccessful, as the noxious gas is generated when the vapors come into contact with the acid, and must be got rid of, thus resembling the old process. These inconveniences the patentee proposes to obviate by operating in the following manner:—The liquor is placed in a vessel similar to an ordinary steam-boiler, and heat is applied thereto by means of a furnace. The liquor consists principally of hydrosulphuret and carbonate of ammonia, with small quantities of other salts of that base. As soon as the temperature rises the hydrosulphuret of ammonia comes over, it being the most volatile product; a slow fire is kept up, so as to volatilize this product exclusively; and as it is given off it is conducted by a branch from a horizontal pipe into a vessel containing a solution of some substance which has the property of absorbing the sulphuretted hydrogen—the deleterious gas. The salts of iron and manganese possess this property, as has been already stated; and alkalies, or lime, mixed with water, will also effect the same object. In the former case, the product, after sufficient of the vapors have passed to saturate the material employed, is a solution of a salt of ammonia, holding in suspension the sulphuret of iron, or manganese. In this plan, one vessel for holding the material through which the vapors are passed is sufficient; but if more be employed, they are charged with the same solution. When lime, or alkali, is used to absorb the sulphuretted hydrogen, the ammonia is liberated, and must be conducted into a second vessel charged with an acid. At the end of this part of the operation, that is when all the hydrosulphuret of ammonia has passed over, the products found in the first vessel are sulphuret of lime and some free ammonia, and in the second, a solution of a salt of ammonia. If the acid was but slightly diluted, the solution may be obtained saturated and fit to crystalize on cooling. The liquid remaining in the boiler, and now consisting principally of carbonate of ammonia, may be treated in the ordinary way for preparing the salts; that is, it may be neutralized with an acid, and the resulting solution evaporated in lead vessels, to obtain the crystals of the ammoniacal salts, as is well understood; or the evaporation may be continued in the boiler at a higher temperature, in order to drive over the other volatile salts, and the vapors passed through acid to absorb the ammonia. In the latter case, the apparatus just described may be used, a cock in the horizontal pipe being opened. The vapors then pass through the horizontal pipe, and down a branch-pipe into the second vessel containing the acid, without entering the first vessel containing the lime, and are then absorbed. The evaporation is continued until the volatile salts of ammonia are all driven off, when the liquor in the boiler may be rejected, unless it be found that the fixed salts remaining in the liquor are in sufficient quantity to be worth extracting, which may be ascertained, approximatively, by evaporating a drop of the liquor on a strip of glass, or accurately, by evaporating, nearly to dryness, a known quantity of the liquor, and by weighing the resulting salt. These fixed salts may be obtained by entirely evaporating the liquor in a leaden vessel, or by adding to the liquor, while in the boiler, a certain quantity, more or less, according to the amount of the fixed salts present, of sulphuret of lime in solution. This substance may be obtained from the first part of the operation when lime is used, or from the liquor of the wet purifiers of the gas-works. The sulphuret of lime decomposes the fixed salts of ammonia, liberating the latter substance in the state of hydrosulphuret, which may be treated in the same manner as that evolved in the first stage of the process.—[Sealed, Dec. 20, 1845.]

London Chemical Gazette.

On the Velocity of Atmospheric Jets.

Communicated by Z. Parker.

The following table of the velocity of atmospheric jets, under the given pressures, may be useful.

The table is constructed under the assumption that all fluids acquire equal velocities under the pressure of equal heights, without regard to their specific gravities; allowing the superincumbent column to be homogeneous with that portion at the jet. The formula is $V = \sqrt{64\,h}$; and for a pressure of 15 lbs. per square inch, $h = 27{,}600$ feet of homogeneous atmosphere. The height for other pressures in proportion.

Pressure per square inch.	Velocity, feet per second.	Pressure per square inch.	Velocity, feet per second.	Pressure per square inch.	Velocity, feet per second.
¼ oz.	42	2¼ lbs.	514	13 lbs.	1237
½ "	60	2½ "	533	14 "	1284
1 "	88	2¾ "	569	15 "	1329
2 "	121	3 "	594	20 "	1534
3 "	148	3¼ "	615	30 "	2004
4 "	171	3½ "	642	40 "	2170
5 "	190	3¾ "	665	50 "	2406
6 "	210	4 "	686	60 "	2658
7 "	227	4½ "	728	70 "	2871
8 "	242	5 "	760	80 "	3069
10 "	271	5½ "	804	90 "	3240
12 "	297	6 "	840	100 "	3431
14 "	321	7 "	908	110 "	3600
1 lbs.	343	8 "	970	120 "	3759
1¼ "	383	9 "	1029	130 "	3912
1½ "	420	10 "	1085	140 "	4060
1¾ "	453	11 "	1136	150 "	4202
2 "	485	12 "	1208	160 "	4340

Erratum.

In the Report of the Committee on Exhibitions, on page 368 of the December No., in lines 13 and 14 from foot of page, instead of *W. P. Cresson,* read *Walter Cresson.*

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA,

FOR THE

PROMOTION OF THE MECHANIC ARTS.

FEBRUARY, 1848.

CIVIL ENGINEERING.

First Annual Report of the Directors of the Pennsylvania Railroad Company, to the Stockholders, October 30, 1847.

Gentlemen,—The period has arrived when, under the provisions of the nineteenth section of the Charter of the Company, the Board are required to present to you an account of their proceedings before surrendering to you the trust which has been confided to them.

Upon entering the duties assigned to them, in the prosecution of a work of such magnitude, in which their fellow citizens hold a deep stake, and in which the future prosperity of the city is largely interested, the Board felt their responsibility, well knowing that a false step at the commencement would damp the ardor of its friends, and jeopardize its final success.

Earnest consideration was therefore given to the most effective organization of the Engineer corps, upon which success in a great measure depended, and the Board determined to place that department under an efficient head, who should control the whole, with two associates, to have charge, under his direction, of the two divisions of the road respectively.

In the selection of a Chief Engineer, the Board were fortunate in obtaining the services of Mr. John Edgar Thompson, a gentleman of enlarged professional experience and sound judgment, who had obtained a well earned reputation upon the Georgia road, and in whom the Board place great confidence.

The office of Associate, West, was filled by the election of Mr. Edward Miller, a gentleman well known and appreciated in this community, who has occupied several prominent positions in his profession, with entire credit to himself, and enjoys the merited confidence of all companies who have employed him.

As Associate, East, Mr. Wm. B. Foster, Jr., was appointed, a gentleman who has for years filled important stations, in connexion with the State works, and who has proved himself an able and efficient officer.

The experience of the past summer has satisfied the Board that in the organization of this department they have nothing to regret.

The Board, at an early day, turned their attention to an object, which they deemed it incumbent on them to secure if possible, for which their constituents had manifested great solicitude, and took immediate measures to prevent the Baltimore and Ohio Railroad Company availing itself of the Law passed by the Legislature of this State, granting to that Company the right of constructing a road from Cumberland to Pittsburgh.

To effect this, a subscription to the amount of three millions of dollars, and the payment of one million into the treasury of the Company, were required by the Act of Assembly, and to have fifteen miles of road put under contract for construction at each terminus of the Pennsylvania railroad, prior to the thirtieth day of July, 1847. The instalments were therefore called payable on the first days of May and July, and were promptly met by the stockholders. These instalments, with that already paid at the time of subscription, amounted to nine hundred thousand dollars, and the deficiency was met by payments, in anticipation of the fourth instalment, from Stockholders, who came promptly forward to a sufficient extent, some of whom paid up their stock in full.

In the month of July, contracts were made for the construction of the road the required distance, and on the second of August, the Governor issued his proclamation, declaring the law giving to the Baltimore and Ohio Railroad Company the right of way through Pennsylvania null and void.

The good effect of this measure upon the general interests of the Company has been made strikingly manifest, by putting it, in the offset, in a state of high credit, and by imparting to it a public confidence which cannot fail to facilitate future subscriptions that may be necessary for the completion of the road.

The policy to be pursued by the Board in the management of this work was plainly indicated.

The law requiring fifteen miles at each end to be put under contract was fulfilled, but at this point so unwise a course stopped.

With this exception, the attention of the Board was directed to the Eastern end, with a view of bringing into profitable use that portion of the road which would soonest make a return to the stockholders.

An examination of the different routes which had been indicated by former surveys and public opinion, led irresistibly to the conclusion that the Valley of the Juniata was, on all accounts, to be preferred, presenting greater facilities, easier gradients, and less distance, with the decided advantage of being brought into profitable use at a much earlier period than either of the others.

Accordingly, it was determined to adopt and place it under contract as rapidly as it could be prepared by the Engineers. Twenty miles were let in July, which are now rapidly progressing towards completion. Forty miles further, to Lewistown, will be let to contractors on the twenty-sixth of November, and the Engineers are now actively engaged in locating the line, with a view of placing the remainder of the eastern division, to the base of the mountain, under contract early in the spring. As soon as the Engineers have completed their operations, a report from the Chief Engineer, with an estimate of the cost, will be made and published for the information of the stockholders.

The surveys and location of the western division cannot be completed until early the ensuing summer, but sufficient information will be obtained from the surveys of this year to enable the Engineers to give an estimate of the cost of the whole road, with considerable accuracy. The line of the road upon the eastern side of the mountain has been finally determined and proves highly favorable. The whole length of the road from Harrisburg to Robinson's ridge, at the foot of the Allegheny, is one hundred and thirty-five miles, upon which there is no ascending gradient exceeding sixteen feet per mile to Lewistown, and twenty-one feet for the remainder of the distance, nor a descending gradient exceeding ten and a half feet per mile.

From Robinson's ridge, which divides the little Juniata from the Frankstown branch, north of Brush mountain, the ascent of the Allegheny is commenced, and overcome (with the use of locomotive power) by a gradient of about eighty feet per mile in thirteen miles, without encountering any extraordinary difficulties. This work will be left for a future period, and in the mean time a junction will be formed with the Allegheny portage by a branch line, six miles in length, from Robinson's ridge to Hollidaysburg, or some point further west. From the summit of the Allegheny to Pittsburgh, the line will pass over an uneven country, requiring maximum gradients of fifty feet per mile in both directions. The whole length of the road from Robinson's ridge to Pittsburgh will fall somewhere between one hundred and ten to one hundred and twenty miles.

The general plan determined upon by the Board is to proceed with the western section as soon as the eastern division is complete, unless means are provided to prosecute both simultaneously, and to bring them into use by connecting with the Allegheny Portage, while the mountain, or middle, division is in the course of construction.

From present prospects, the Board anticipate being enabled to run their cars from Harrisburg to Lewistown before the close of the winter of 1848–49, and the winter following, with the means now at their command, to connect with the Portage at Hollidaysburg, which, with the completion of the western fifteen miles, will give a continuous railroad communication between Philadelphia and Pittsburgh, with the exception of fifty-five miles to be traveled by stages; and the Board anticipate at that time a very large proportion of western travel over the road.

The importance of securing a supply of iron in time early engaged the attention of the Board, and they were desirous of obtaining it from the mines of Pennsylvania. With this view, they offered to contract for a sufficient amount to afford an inducement to erect new iron works for its manufacture.

After some negotiations, they finally closed with the offer of David Reeves for fifteen thousand tons, the amount required for the eastern section, at sixty and one half dollars per ton, being about ten dollars per ton less than the market price at that time on the seaboard. The amount required, and prospect of future orders, determined the bid, which was considered a very advantageous operation for both parties. Mr. Reeves has commenced the erection of his works in Lancaster county, and will be prepared to deliver iron in the month of June next, being the time it will be required for the track.

Since the period when this enterprise was first undertaken, a marked change has manifested itself in the public mind with respect to its feasibility and prospects of profit. At that period, the subscription to the stock was considered by many as a patriotic endeavor to retain and extend a trade which legitimately belonged to this city, and which was about to be wrested from her grasp by her enterprising rivals.

A glance at the subscription book attests the existence of this feeling, for out of some twenty-six hundred subscriptions near eighteen hundred are for five shares and under. The books at that time were carried from house to house by the active friends of the road, who solicited even single shares, and the powerful aid of public opinion was brought to bear upon the city authorities to induce a large subscription, lest private enterprise should be inadequate to the task. Of the importance of the work to the true interests of the city and State no one ever entertained a doubt. If any had been entertained, the recent disaster to the State public works of Pennsylvania must have removed it.

In a single night, the whole range of canal along the Juniata was swept by the flood; more than twenty thousand tons of goods in transit left along its banks, to be wagoned east and west at a heavy expense, and the channel of communication between the east and west interrupted for nearly two months, leaving the country full of produce, coal, and iron, unable to find an outlet to market for the next six months, and materially interrupting the business prospects of the merchants both of Philadelphia and Pittsburgh.

Such an occurrence, which the canal must at all times be subject to, has awakened the attention of the whole country to the necessity of pressing the work forward with the utmost vigor.

As an investment, this work is now viewed in a very different light from what it was a year ago.

Since the road has been seriously undertaken, with an earnest determination to bring it rapidly to a completion, its prospects have been more carefully scrutinized, and every fact which has been developed in the public prints has gone to show that when in operation it has a field open to it which no other enterprise of the kind presents.

Already the citizens of Ohio are combining their energies to extend our line through the fertile valleys of that State, and form a continuous way from the Atlantic to the far west. Even from Pittsburgh alone, a vast trade must open to it, which has never been taken into account, in the single item of cattle, of which more than fifty thousand are annually driven through Pennsylvania from Ohio, and which can be transported over the road at a large saving to the drover, yielding abundant profit to the Company.

That the Pennsylvania railroad must yield an immediate profit on the investment is generally admitted by all well-informed persons, and we may now look to capital seeking investment, and not to patriotism to furnish it.

The manifest advantages to be derived from an early completion of the whole line call for a recommendation from the Board that immediate steps be taken to raise sufficient capital to render it available in the shortest possible period.

The amount now subscribed exceeds three millions of dollars, which, it is safely calculated, is sufficient to put the road in operation to the base of the Allegheny, and connect it with the State Portage. This portion of the work is now being constructed as rapidly as is consistent with judicious economy.

The western section may be considered as a distinct work, and can, without detriment to the interest of the Company, be put under contract at the same time as the eastern, thus effecting a saving of nearly two years in the completion of the whole. A united effort should, therefore, be made both in the east and the west, in order to enable the Board to commence the work as soon as the surveys are complete.

It is fortunate that the unfriendly feelings which divided us from our western fellow citizens have been allayed, on both sides, by time and calm reflection. Both parties now see that their interests are inseparably united, and we have the strongest assurances from prominent persons, who were most active in forwarding other interests, that they are ready to unite with us, and give their hearty co-operation. Measures are now in progress in Pittsburgh which, it is hoped, will lead to a large subscription from the citizens and authorities of Allegheny county.

To place the Company in a strong position, and unite all interests in its behalf, some legislation will be important, which, it is supposed, will not be difficult of attainment, as many interests which heretofore were adverse will now act in accordance with the wishes of the Company.

A careful examination of the law will be made prior to the ensuing session of the Legislature, with a view to such minor changes as will add to its efficiency. The Board now call the attention of the Stockholders to two important amendments, for their sanction.

One, which will materially affect future subscriptions, is the supplement presented and asked for at the last session, granting to municipal bodies the right to subscribe to the stock of the Company; a law which would, under certain restrictions, give the Company the right to accept the certificates of loan issued by municipal corporations in payment of instalments for stocks, will have a most beneficial effect upon our subscriptions.

The tenth section of the charter of the Company provides that, after bona fide contracts shall have been made for the immediate construction of fifteen miles of the road at each end thereof, a sum equal to five per cent. per annum on the capital stock of said Company actually paid in shall be estimated and paid to the several holders thereof, on account of the amounts payable by them respectively for stock subscribed, to be charged to the cost of construction.

This clause was doubtless intended by the Legislature to place the original stockholders upon a just footing in point of interest on their capital with those who might subscribe at later periods, who would otherwise participate equally in advantages accruing from the early subscriptions of their more enterprising neighbors. This intention was equitable, and tended to induce early subscription, but does not meet the exigencies of the case.

The consideration of this clause has led to an inquiry into the policy of paying interest upon all subscriptions semi-annually in money, from the day the instalments are required to be paid, with a view not only of inducing subscriptions, but also of placing all stockholders upon equal ground. The objection that may be urged, that the Company will pay out as dividends that which it has not earned, will not bear the test of scrutiny.

It is perfectly true that the Company has earned no money to divide; but, whether the interest upon the capital paid in while the road is making is sunk, or appears only on the private books of the shareholders, or whether it is credited on the books of the Company on account of future instalments to be paid, or whether it is actually paid out, and new stock subscribed to meet the demand, the effect is the same. For in either case interest is an element in the cost of construction, and must be added to the capital expended. By this latter course, the effect produced is, that the capital stock, when the road is finished, represents exactly the cost, principal and interest, and every shareholder, early or late, is placed upon the same footing.

In considering this question, it is well to take warning from experience, and compare the practice in Pennsylvania with that of other States.

The large public works of this State, constructed by private means, it is believed, almost without exception, have been undertaken upon inadequate capital. Their projectors have raised sufficient funds by subscriptions for the commencement, and trusted to loans, at fixed interest, for the completion, hoping to obtain sufficient profit to pay off the debts and give excessive dividends to the shareholder.

The result of this policy has been almost universally a disappointment. The property of the stockholders, has, in many cases, been sacrificed to pay an interest to loan-holders. Money has been raised at usurious interest by the sale of bonds below their par value; and, in cases where the works would have paid a fair remunerating profit if they had been constructed at their fair cash cost, they now labor under an accumulation of debt, which absorbs all the profit of the concern to pay the interest. Hence it is that capitalists in this city are backward in entering into new projects of public improvement, as their confidence in success and early returns is much shaken by the policy which has heretofore been pursued.

The example drawn from the practice here should be avoided, and the Pennsylvania railroad carried through upon its legitimate capital without debt, and this can only be accomplished by the payment of a moderate rate of interest to shareholders, during the progress of the work. Parties may not be found to the required extent who are willing, or able, to forego their income, while so large a work is in the course of construction, but if an income is regularly paid, any reasonable amount of capital may be obtained for a road which must, when finished, pay a remunerating profit.

It is fortunate that our work is of such a nature that it will not long require the exclusive use of capital to pay the interest, because every section, when finished, will bring in immediate returns in aid of the interest paid. A considerable profit will accrue when the road is in operation to Lewistown, and in another year, when it is connected with the State road at the Allegheny Portage, the income will be still further increased in proportion to the cost, and it is doubted whether the semi-annual payments for interest will ever prove a very serious burthen.

The line of policy now recommended by the Board is, to ask the passage of an amendment to the charter, requiring the Company to pay, semi-annually, an interest equal to six per cent. per annum upon all instalments as called for, (a charge of one per cent. a month being now provided upon delinquencies,) which interest is to be charged to cost of construction, and to credit the same account with all earnings until they amount annually to a sum sufficient to pay dividends to that amount.

In recommending the payment of interest, the Board do not propose any new experiment. This plan is sanctioned by the practice of English companies, as well as those of New York and Massachusetts, and has been followed by the most beneficial results.

Although it is understood that no provision exists in the charters granted in these States for the payment of interest, yet for the last six years such payments have been voluntarily made by all companies, under a conviction of the policy and equity of the measure, and it is found that it not only has the advantage of securing prompt payments from the stockholders, but it permits persons of limited means to invest in these stocks, with a certainty of receiving their incomes regularly from the time of such investment.

The ultimate effect has been that all the roads but one in Massachusetts have been built upon their capital stock, only a single company having been obliged to have recourse to loans, to complete their road.

In New York it is understood that the same course obtains, and that the Hudson River Company pay to the shareholders an interest of seven per cent. as the work progresses.

In looking forward to the trade likely to accrue from an extension of the Pennsylvania road to the west, and in view of meeting the efforts that might be expected to divert that trade, the Board thought it expedient that a committee should visit Ohio during the past summer, in order that they might understand the interests that would probably be brought to bear upon their future prospects. Accordingly they delegated Messrs. J. R. Ingersoll, Ralston, Spangler, and Cresson, as a committee for this purpose. The report of that committee was highly satisfactory, and a correspondence was opened by them with intelligent and enterprizing citizens, interested in works of internal improvement in various parts of the State. From the inquiries of the committee, it is understood that an active spirit of enterprise has been awakened in that State, and that the most strenuous exertions are making to reach the Atlantic by railway communication.

The enormous increase of trade consequent upon the demand for provisions and bread-stuffs upon the Atlantic coast for shipment, has satisfied their citizens that channels of communication liable to interruption for a large portion of the year will not meet the demands of commerce, and hence their attention is turned to means of transportation upon which they can rely with certainty at all seasons.

Two great chains of railroad are contemplated through the State of Ohio, towards which decided measures have been taken. The first and most forward in its prospects, is that leading from Cincinnati through Columbus, and thence eastward till it touches the Ohio river at some point where it can connect with a railroad to the seaboard.

This road connects with the Cincinnati and Sandusky road, which is already in operation as far as Zenia, or Springfield, and passes through Columbus and Newark, to the mouth of Licking River. From this point two routes present themselves, one to Wheeling, through Zanesville, and the other in a north-eastern direction, till it strikes the river about Wellsville. The road, for a part of the distance, is in the hands of organized companies, who will carry on their work by local means, until they come to the point of divergence. This road is of too important a character to stop at such a point, as it will bring over it, for a large part of the year, most of the travel south of Cincinnati. Its movements from the mouth of Licking river must be governed by the probability of reaching the Atlantic in the shortest probable period. The tendency of trade from the country through which this road passes, is, from long habit, to Baltimore, a tendency created by the existence of the national road, and if, on arrival there, it shall be seen that the Baltimore and Ohio road is likely to reach the river first, the probability is in favor of the Wheeling route. If, on the contrary, it shall appear that the Pennsylvania road can first be finished, we may look with confidence to its being the recipient of that great trade.

In taking Columbus as the starting point, the distance estimated to Philadelphia is a few miles less than via Wheeling to Baltimore, and as the mass of travel tends to the north, the distance between Baltimore and Philadelphia is saved to the traveler. It is believed to be a fact, that four-fifths of the through travel over the Baltimore and Ohio road take the line to Philadelphia without stopping at all in that city.

With such a prize as the southern Ohio trade in view, the energetic prosecution of the Pennsylvania road is of the utmost importance, as our success depends upon rapidity of motion. An additional argument is brought home to every stockholder to induce him to assist in placing the Company in a position to prosecute the western section simultaneously with the eastern.

Still more important to the interest of this road is the Central, or "Back-bone," line, as it is aptly termed, through the table lands of Ohio, which has been projected and is in a fair way of prosecution.

This road will traverse, almost in a straight line, the rich belt of wheat lands which extends through the whole State, and embraces a fertile and thickly populated region, and crosses every railroad that can be made from the south to the lakes. The movements towards the construction of this road have already commenced with spirit and will be conducted with energy.

The country which it traverses is sufficiently populous and rich to make it, and, from the peculiar topography of that region, its cost will be moderate and its profits large. It is difficult to appreciate the extent of trade and travel that it will control. It commands a vast amount of trade which now finds its way to the lakes, and borders, for its whole length, the rich grazing country of the north of Ohio.

From its geographical position, this trade must come to Philadelphia, and may be looked to with confidence, both as a profit to our road, and an increase of the trade of the city. Already a portion of it from Wellsville, west, is under contract. Charters exist which will cover a large portion of the ground, and application will be made to the Legislature of Ohio during the ensuing winter to connect these charters, so as to give the whole line, from the eastern to the western borders of the State, into the hands of one company, who will at once commence their operations.

In view of the construction of these roads, which are destined at a very early period to throw upon the Pennsylvania railroad a trade of great magnitude and value, the Board turned their attention to the connexion which must be made between their western terminus and the Ohio State line, and being satisfied that the true policy of the citizens of Pittsburgh is to unite cordially, and with their whole strength in the completion of the road connecting the two cities, they took upon themselves the responsibility of guaranteeing to their fellow citizens of that city that this connexion should be made as soon as the requirements of the trade should make it advisable. And they still hope that the same view will be taken by our brethren of the west, and they will yet receive their hearty co-operation.

The Treasurer's report, herewith presented, will exhibit the state of the finances. Balance in hand, $953,303·86.

It is hoped that, with the new contracts about to be made, they will soon be able to expend these funds with rapidity. No calls will probably be made until the ensuing spring, of which due notice will be given.

The Board have to regret the loss from among their number of an ardent friend of the road, Henry C. Corbit, Esq., who was compelled to resign in the month of May, from ill health. The vacancy was filled by the election of Jesse Godley, Esq., on the seventeenth of that month.

In surrendering this important trust to their constituents, the Board cannot refrain from mutual congratulations upon the auspicious commencement and present prospects of a work destined, at no distant period, to form a main connecting line between the west and the Atlantic, and add largely to the trade and prosperity of the State and city.

All of which is respectfully submitted.

By order of the Board.

S. V. Merrick, *President.*

Office Pennsylvania Railroad Co.,
Philada., 30th Oct., 1847.

The Treasurer Reports,

Amount received from stockholders in payment of

First Instalment,		$303,725·00
Second "		298,940·00
Third "		296,955·00
Fourth "	in advance,	50,815·00
Fifth "		640·00
Sixth "		200·00
Seventh "		100 00
Eighth "		50.00
Ninth "		50·00
Stock in full,		66,250·00
		$1,017,725·00

And *expended in*

Organization and Expenses,	$10,518·99	
Engineering,	23,116·11	
Graduation,	10,166·02	
Real Estate,	1,575·00	
Right of Way, Fencing, and Damages,	5,413·15	
In hands of Agents,	13,631·87	
		$64,421·14
Balance in hands of the Company,		$953,303·86

George V. Bacon, *Treasurer.*

Philadelphia, October 30, 1847.

The following communication from the Chief Engineer is appended:

Engineer Department Penn'a Railroad,
Dec. 1st, 1847.

Sir:—In consequence of the lateness of the season at which he surveys for the Pennsylvania railroad were commenced, it will be out of my power to furnish, at this time, a satisfactory description and estimate of any considerable portion of the route. I should, therefore, prefer deferring a detailed report of our operations for a few months, when the estimates, founded upon the surveys now about closing, will be made out.

I can, however, state, for the information of the Board, that we have —within the short space of four months from the time the parties took the field above Lewistown— determined the route of the whole of the eastern division of the road. The surveys made have been very extensive, and are entirely satisfactory and conclusive in their results; leaving no doubt upon my mind in relation to the superiority of the route selected. Indeed, a better line than we have obtained could scarcely have been expected. The whole distance from Harrisburg to the foot of the Alleghenies is 134 miles, and upon this distance, the maximum ascending gradient to Lewistown does not exceed sixteen feet per mile, or descending eight feet; and above that place the greatest ascent per mile is 21 feet, and descent 10½ feet.

The foot of the Alleghenies is reached at Robinson's Summit, on the ridge dividing the Frankstown Branch and Little Juniata river, west of the Brush mountain. From this point, the great barrier separating the east from the west, can be ascended by a continuous gradient of 80 feet per mile, for 12¼ miles, without encountering any very extraordinary difficulties, overcoming an elevation of 980 feet, and passing to the west side of the mountain, at Sugar Run Gap, by a tunnel 760 yards long and 160 feet below its apex. This gradient is less than the maximum ascent used on the Boston and Albany railroad, and also on the Baltimore and Ohio railroad, at the ridge between the Patapsco and Potomac. It may be reduced to 75 or 76 feet per mile by a longer tunnel at the mountain summit, and a slight prolongation of the gradient eastwardly.

From Robinson's Summit, a connexion can be effected with the Allegheny Portage railroad by a branch of six or seven miles in length, over favorable ground. This connexion should be made simultaneously with the main line, if the Commonwealth should appropriate the means necessary to place the Portage road in a condition to do the additional business that we will throw upon it.

The maximum gradient best adapted to the western division has not yet been determined, but it is believed that it cannot be advantageously reduced below fifty feet per mile. One line has been located through from Pittsburgh to Blairsville, via Turtle Creek, the profile of which, by the use of a higher gradient and a more minute examination of the country, has been greatly softened in its asperities over that made from Mr. Schlater's surveys. Three of the tunnels recommended by him have been dispensed with. Another route, by the valley of Brush Creek, passing through Greensboro', and intersecting the Conemaugh at the point of Chesnut Ridge, is being located, which, though longer, does not present quite so rough a surface as that by Blairsville.

The distance from Harrisburg to the summit of the Allegheny is 146 miles, thence to Pittsburgh it will be about 104 miles by the Conemaugh and Blairsville, and 96 miles by the Blacklick and Blairsville route, making the total probable distance, on the shortest route, from Harrisburg to Pittsburgh 242 miles.

The whole line will be admirably arranged for cheap transportation, not only on account of the adaptation of the gradients to the direction of the heaviest trade, but also from the steeper gradients occurring where fuel will be unusually cheap; bituminous coal abounding upon their whole extent, and may be obtained at from 60 to 90 cents per ton. The mountain gradient divides the eastern and western divisions of the road, and the low from the higher system of gradients—up this steeper inclination the trains, when heavily laden, will be assisted by additional locomotive power.

The contracts entered into for 20 miles of the graduation on the eastern division, in July, have all been commenced, and it is believed that all, except that including the Susquehanna Bridge, will be finished by the time allotted. The latter is now progressing with much vigor. Upon the western end, but few of the contractors have commenced their work; ample time having been allotted them to complete their contracts, it has not been deemed necessary to push them.

Very respectfully,
Your obedient servant,
J. Edgar Thomson, *Chief Engineer.*

To S. V. Merrick, Esq., *President.*

Annual Report of the Managers of the Union Canal Company of Pennsylvania, to the Stockholders, Nov. 16, 1847.

Since the last annual meeting of the stockholders, several very favorable changes have taken place in the affairs of the Company. At that time some of the loanholders, having refused in writing to agree to the consolidation of the loans with the stock, prevented the removal of the assignment by which all the property of the Company was placed in the hands of a trustee. Last spring the Managers succeeded in getting these loans converted into stock, and the property restored to the hands of the Company. The capital now consists of 13,511 shares of

$200 each, amounting to	$2,702,200·00
And fractions of shares amounting to	42,421·40
Making the entire capital,	$2,744,621·40

The debts secured by the deed of trust, for steam engine, interest due to loanholders prior to assignment, &c., have been paid, thus leaving the Company entirely free from debt.

Extensive repairs and renewals of mechanical structures have been made during the past year; a large portion of the summit level has been relined; nearly the whole of the feeder leading from the water works has been rebuilt; the railroad has been relaid with heavy flat bar iron; several aqueducts have been renewed; a new house for the weighmaster at the water works, and a lock-house on Branch canal, have been erected.

The canal continued open until the 5th of December, when it was closed by ice. The navigation in the spring began on the 30th of March, (having been delayed by the completion of repairs,) and has continued uninterrupted since then, with the exception of a short distance at the eastern end, for a few days, occasioned by a flood of unusual height, and the Branch canal during the same period, the navigation of which was rendered dangerous, if not impracticable, by the height of the water.

The trade on the canal has increased very much the past year, as will be seen from the following table; the tonnage this year exceeding that of any previous one by 688 tons, although the tolls are not so large:—

Years.	Tons.	Tolls received.	Av. rate per ton.	
			Cts.	mills.
1828	18,124	$15,512	·85	5
1829	20,522	16,676	·81	3
1830	41,094	35,133	·85	5
1831	59,970	59,137	·98	6
1832	47,645	59,061	1·23	9
1833	85,876	103,462	1·20	5
1834	84,536	119,870	1·41	8
1835	118,978	135,254	1·13	7
1836	117,136	133,025	1·13	6
1837	110,032	107,590	·97	8
1838	126,870	123,575	·97	4
1839	138,568	135,163	·97	5
1840	115,292	110,855	·96	1
1841	83,624	66,601	·79	7
1842	83,106	57,477	·69	2
1843	76,959	53,538	·68	2
1844	79,871	56,580	·70	8
1845	102,593	60,036	·58	5
1846	114,920	62,682	·54	5
1847	139,256	91,356	·65	6

The Pine Grove coal trade has also steadily increased, but yet slowly, as is shown by the statement below:—

Years.	Tons.	Years.	Tons.	Years.	Tons.
1833	3,500	1838	15,000	1843	22,000
1834	6,911	1839	20,885	1844	29,000
1835	14,000	1840	20,500	1845	35,000
1836	12,000	1841	19,500	1846	55,500
1837	17,000	1842	32,500	1847	60,499

Another coal field, on Fishing Creek, may be brought into operation by constructing a railroad for a few miles; and, by continuing it through the Fourth mountain by a tunnel, Williams' Valley may be opened to the Union canal. A new market for coal has also been opened at Lebanon, where one anthracite furnace has been blown in during the past year, and another stack is now nearly completed. There are other points, also, on the Union canal, advantageously situated for the iron business, and which will probably, ere long, be occupied by furnaces and other works.

The foregoing considerations naturally lead us to a matter of great importance to the Company, viz. the enlargement of the Canal. The subject was introduced last year to the meeting of stockholders by resolutions appended to the annual report, but was not then acted upon. The Board desire again to call the attention of the stockholders to this important matter, and to ask such action by them as will secure the enlargement of the entire line at an early date. At present, nearly the whole trade of the Susquehanna and its tributaries is diverted from its natural channel through Pennsylvania, to a circuitous route through two neighboring states, and to the obvious injury of this Company. The trade of the Susquehanna is annually and rapidly increasing, and is now so large that it can be with difficulty passed by a single set of locks. The boatmen are anxious to have the Union canal enlarged to accommodate the Susquehanna and Juniata boats, on account of the safety, cheapness, and healthiness of the route; while the Schuylkill Navigation Company would be benefitted by the increased tolls, and the property owners on the Schuylkill would receive a corresponding advantage by bringing the trade again to the western front of the city.

The Managers believe that the Company has already obtained all the legislative action necessary. They are authorized to increase their capital stock, or to borrow money, and secure the same by mortgage of the property and franchises of the Company. Surveys of the canal have been made, and estimates of the cost of enlargement. Nothing is now wanting to accomplish it but the determination of the stockholders to do it, and the money for paying the cost. Some kinds of trade cannot be obtained so long as the canal remains of its present dimensions, and there is an unwillingness to build boats of 30 tons burthen, when there is a prospect of their being thrown out of use in a few years. This consideration should bring the stockholders to an early decision of the question, whether the canal is to be enlarged, or to remain of its present size.

An inconvenience now exists, occasioned by the time of closing the financial year of the Company on the 31st of October. The trade continues for some weeks after that date, and thus the business of parts of two years are included in our statements. It may be worthy of consideration, whether it would not be advantageous to have the time of closing the accounts changed to December 31st, and that of holding the annual meeting for electing officers to February. A change of the par value of shares might also be advisable to make them correspond with those of other companies.

The Managers would conclude their report by proposing the following resolutions for the consideration of the meeting:

Resolved, That the Managers of the Union Canal Company be and they are hereby authorized, to take such measures as may be necessary to procure the requisite means for enlarging the canal, or any portion thereof, to the size of the Pennsylvania canal, either by a new issue of stock, or by loan, or in such other manner as they may deem expedient.

Resolved, That the Managers be requested to make application to the Legislature for power to change the time of closing the accounts of the Company, and of holding the annual meeting of stockholders, and also for dividing the shares of the capital stock into shares of fifty dollars each.

The Treasurer's accounts of receipts and expenditures, together with a table showing the tonnage which has been transported on the canal during the past year, are herewith presented.

By order of the Board.

ROBT. B. DAVIDSON, *President.*

Philadelphia, Nov. 16th, 1847.

Statement of the Tonnage which passed the Union Canal, from Nov. 1, 1846, *to Nov.* 1, 1847.

	Tons.	Cwt.	Qrs.
Flour, 23,470 barrels, - -	2,200	6	1
Grain, 342,176 bushels, - -	8,707	2	3
Iron, - - - -	8,202	9	3
Iron Ore, - - -	9,512	18	2
Anthracite Coal, - - -	62,549	8	0
Bituminous Coal, - -	2,702	7	0
Charcoal, - - -	258	15	1
Lumber, 25,010,994 feet, -	25,233	16	0
Shingles, 6,869,193, - -	3,066	12	0
Whiskey, 337 barrels, - -	45	3	1
Salt, 40,416 bushels, - -	1,087	17	2
Tobacco, - - -	76	7	0
Plaster, - - - -	1,793	7	1
Lime, 43,056 bushels, - -	1,537	14	1
Limestone, - - -	3,313	15	1
Seeds, - - -	58	2	0
Leather, - - - -	66	6	0
Butter, - - -	57	12	2
Nails, - - - -	13	8	0
Fish, 2204 barrels, - -	299	13	0
Merchandize, - - -	550	1	0
Cordwood, 2782 cords, - -	3,725	17	3
Sundries, - - -	4,197	18	2
	139,256	18	3

139,256 tons, 18 cwt., 3 qrs., of 2240 lbs.

Mr. Samuel's Railway Express Engine.—Light Engines for light weights.

To those who can read the signs of the future in the indications of the present, last Saturday was an epoch in railway affairs; for, on that day, "thought became a fact," pregnant with consequences. On that day, the resident engineer of the Eastern Counties' Railway, by the aid of *twenty-two hundred weight* of metal, timber, fuel, and water, conveyed seven persons from London to Cambridge, at the rate of 40 miles per hour—a feat which, up to that period, could only be accomplished by putting in motion *thirty tons* of inert matter. To those who ask the *cui bono?* we reply that it is an indication of a reduction in the working expenses of railways, by the diminution of dead weight—an indication of increased durability of rails and roadway, and reduction in the cost of maintenance of way—an indication of greater speed than has yet been attained, and at a lessened cost—an indication of yet cheaper transit to the community, with increased profit to the shareholders—an indication of the extended use of railways, in many modes not hitherto dreamt of—an indication that steam carriages on railways may be advantageously applied to many purposes for which steam tugs (the existing locomotives) are not well adapted—and more than an indication, a direct offer, by authority, to the periodical press, to forward their reporters and messengers to the various scenes of their labors, on future occasions, at a cost of one-fourth the price hitherto charged. This is no merely curious experiment, but practical everyday business. Several pounds per day is the cost of an ordinary locomotive—fewer shillings is the cost of this new candidate for passenger transit. And be it remembered that this first "steam carriage" on railways, satisfactory though it be, still lacks the improvement of experience. The amount of improvement in the second of its class we cannot yet pronounce upon; but it is calculated that two tons of matter will convey twenty passengers, in a closed carriage, at the rate of sixty miles per hour; 40 cwt. of dead load to 30 cwt. of available load, or duty. And, after that experience be gained, it is probable that the third carriage will, with a dead load of 60 cwt., convey sixty passengers, or 90 cwt., for the dead load will diminish in proportion to the number of passengers.

A stage-coach of former times weighed about 1 ton; the four horses and harness, about 1½ tons—50 cwt.; guard and coachman, 3 cwt.; total, 53 cwt. By this apparatus, 17 passengers were carried at a rate of 10 miles per hour—about 24 cwt.,—so that 2 cwt. dead load carried 1 cwt. available load.

An engine, tender, three first, and six second class carriages, with driver, stoker, and guards, weigh about 70 tons on the Eastern lines. They will carry 192 passengers, at the rate of 30 miles per hour—about 288 cwt. of available load to 1,400 cwt. of dead load, or about 5 cwt. dead load to 1 cwt. available load.

A Great-Western express train weighs about 70 tons. The passengers, 128 in number, weigh about 9½ tons, which will be near 11 cwt. dead load to 1 cwt. available load.

The Eastern Counties' steam-carriage weighs 22 cwt., and carries 7 passengers, weight 10½ cwt.; about 2 cwt. of dead load to 1 cwt. of available load. This is about equivalent to the old stage-coach, in proportion of materials, at quadrupled speed.

But if, at a future time, 3 tons of dead load will carry 4½ tons of available load, that will be the proportion of 1 cwt. of dead load to 1½ cwt. of available load.

It is not possible that principles of so great importance should be suffered to lie in abeyance; and we think that the Directors of the Eastern Counties' Railway have shown great clear-sightedness in sanctioning their engineer, Mr. Samuel, in so important an experiment. We foresee numerous purposes to which these steam-carriages may be applied, and shall be much surprised if the Post-office do not grapple at once with so cheap a means of rapid transit: and we shall also be surprised if it does not induce the Directors to institute inquiries and experiments as to what amount of power is actually generated in their engines, for the purpose of overcoming their own friction. The result of this novel vehicle is most creditable to all the parties concerned. We believe that Mr. Samuel was the original propounder of it, for the Eastern Counties' Railway; and, when sanctioned by the Directors, the working drawings were made, under his superintendence, by his then assistant, Mr. Reynolds. It was constructed by Messrs. Adams, of the Fairfield Works, and we shall be glad to witness the launching of the second of its class from the same establishment.—*Railway Record, Oct. 30th.*

London Mech. Mag.

AMERICAN PATENTS.

List of American Patents which issued in the month of October, 1846,—*with Exemplifications, by* Charles M. Keller, *Agent for procuring Patents, and late Chief Examiner of Patents in the U. S. Patent Office.*

1. For a *New and Useful Self-acting Mule for Spinning Cotton and other Fibrous Substances;* William Mason, Taunton, Massachusetts, October 3.

The patentee says,—"The motions of the mule may be divided into three series, which are subdivided in the action of the apparatus. The first series consists in the drawing out of the carriage, the revolving of the drawer rollers, and the whirling of the spindles, by means of which series of motions the rovings are drawn out and the threads spun and twisted. The second series consists of backing off, as it is termed; that is, turning the spindles the reverse direction, to uncoil the threads from the points of the spindles to the cops, and turning down or depressing the front faller; at the same time, to place all the parts in a proper condition for the third series of motions, which consists of putting or running in the carriage, winding on the yarn or threads, by giving a varying motion to the spindles corresponding to the form and size of the cops, and operating the faller to give the proper shape to the cops.

"The first series of motions is regular. The carriage is drawn out by a regular motion, effected by a train of wheels from the driving pulley to a line shaft, which carries endless chains connected with the carriage at different parts of its length to insure steadiness of motion. During this, the draw rollers are rotated to give out the staple as it is spun by another train of wheels, deriving motion from the same source as the preceding, and in manner substantially similar to other mules; and, at the same time, the spindles are whirled or rotated by a band, receiving motion from a pulley on the shaft of the driving pulley, as in other mules. This completes the first series of motions, in which I claim nothing new.

"At the end of the first series of motions, the threads that have been spun are coiled on the spindles from the cops to their points; it is therefore necessary to uncoil them, (called backing,) preparatory to winding on, and at the same time to depress the front faller, to place it in a proper position for winding on. The second series of motions effects these purposes, and the various parts of the mechanism are put in a proper condition to effect this by the momentum of the moving parts at the end of the first series of motions. This constitutes the first part of my invention. As the carriage approaches the end of the out motion, the driving belt is shifted from the first driving pulley to a loose pulley by the side of it, to permit the momentum of the moving parts to complete the movements; and so soon as these are accomplished, a balance weight is carried beyond the vertical line, and falls over, which shifts the belt from the loose pulley to a second fast pulley on the same shaft with the others; at the same time, the trains of wheels that operate the carriage and the draw-rollers are liberated by the shifting of a clutch, and at the same time a friction clutch is brought into action, thereby connecting the band that drives the spindles with a sliding rack, (called the 'top-sliding rack,') which, in consequence of this connexion, is carried by the momentum of the spindles sufficiently far in one direction to give by its return the required motion to the spindles in the reverse direction, to uncoil the threads from the upper part of the spindles. Whilst the rack is thus moved, the second fast pulley sets in motion, by a train of wheels, a crank pin that works in a slot in a connecting rod, and this crank pin, when set in motion, is a little below a line passing through the connecting rod and the axis of motion, so that the crank pin moves a short distance before it begins to move the connecting rod; this period of time is sufficient to permit the momentum of the spindles (as above stated) to draw the sliding rack to the distance required. to be in a condition, by its return movement, to give the 'backing-off' motion to the spindles. The crank pin, then, in making a semi-revolution, carries the connecting rod with it; and this being in connexion with the lever of a rock-shaft, provided with a toothed pulley, around which passes a chain attached to the end of the sliding rack, draws it (the rack) for a short distance in a reverse direction, and thus causes it to give the backing-off motion to the spindles, to uncoil the threads, at the same time depressing the front faller to bring the threads in a proper position for winding on; this latter being effected by having one end of the shaper or coping rail jointed to a lever on the rock shaft above mentioned. The chain attached to the rack, and which communicates motion to it, is kept tight by being passed over a pulley and having a weight suspended to it. When the top sliding rack is carried forward by the momentum of the spindles, at the end of the first series of motions it is gradually arrested, and with it the spindles, by means of a spring brake of a peculiar construction, viz: On the rock shaft there is a bent lever, to one end of which is connected a helical spring, also attached to an arm jointed to the other end of the bent lever; and by the side of and attached to the toothed wheel, around which passes the chain on the end of the sliding rack, and which turns freely on the rock shaft, there is a ratchet wheel, and by the side of it a cam-plate provided with a hand or catch, by means of which the ratchet and toothed wheels are carried around, when the cam-plate is carried around, by the action of the spring brake on the cam-form of its periphery. And when this has been carried far enough round, the catch is liberated, to permit the return of the parts, by means of an arm or lever jointed to one end of the bent lever, which is made to lift the catch from the teeth of the ratchet wheel. As the cops increase in diameter, it is evident that the backing-off motion must be diminished, and this is effected by making the connecting rod above mentioned in two parts, the first connected by one end (as above stated) with the crank pin which actuates it, and which works in a slot to give motion to the rod in one direction only, (the crank being then at liberty to turn without imparting any motion longitudinally to the rod,) and the other end being jointed to a curved arm, that vibrates on a steel pin, and the other part of the connecting rod is jointed to the arm of the rock shaft, and to a slide that works in a curved groove in the vibrating arm, so that, as this slide is moved from or towards the axis of motion of the arm, the rock shaft will be vibrated more or less; and this slide is moved in or out by being in connexion with the mechanism that operates the motions of the coping rail, and which, therefore, will be described under the third series. At the end of the backing-off motion, the vibrating arm of the connecting rod is hooked and held by a catch until the carriage is run up, and then liberated to permit the parts to resume their appropriate positions preparatory to a repetition of the operations.

"At the end of the second series of motions the third series of motions commences, and these constitute the second part of my invention. The carriage is run in by a crank motion, which has the effect to gradually start it from a state of rest and accelerate its motion to the middle of its course, and then gradually diminish its motion until it is brought to a state of rest; thus avoiding all tendency to break the threads consequent upon all sudden motions. This is effected in the following manner, viz: When the shipping lever is operated at the end of the first series of motions, a clutch on a shaft carried by a second fast pulley is shifted; and as this clutch has but one tooth, the shaft is thereby permitted to make part of a revolution, during which the second series of operations takes place before it (the clutch) begins to act, and then it communicates motion to a large cog wheel provided with a crank pin, that actuates a connecting rod jointed to a rack, (below the top-sliding rack above described,) the teeth of which take into the teeth of a pinion on the shaft of one of the train of wheels that communicates motion to the carriage, thereby imparting the desired movement. The winding on of the yarn during the running in of the carriage is effected by the top sliding rack, which for this purpose is carried by the rack just described, by means of such connexions as admit of modifying the motions of the top sliding rack, which drives the spindles in winding on. Motion is communicated from the bottom to the top rack in the following manner: On the end of the lower rack, and by the side of it, there is a stud-pin on which turns a scroll cam, and to that part of its periphery which is nearest the axis is attached one end of a chain, which passes from thence around a roller that turns on a stud-pin at the side of the lower rack, and is then carried back and attached by a short arm to the top sliding rack, so that when the lower rack slides, the top rack will move with it, provided the scroll cam remains immovable on its axis; but the motion of the top rack, during each operation, must have a motion accelerated relatively to that of the lower rack, to increase the rotation of the spindles as the threads are wound round on a gradually diminishing diameter of the conical form of the cops. This is effected by causing the scroll cam to turn on its axis during the motion of the rack, by having a wheel attached to and turning with it, to the periphery of which is attached one end of a chain that passes round it, and is attached by the other end to another part of the machine, so that, if this part of the attachment remains fixed, a regular accelerated motion will be given to the top rack relatively to the motion of the lower rack, and necessarily the spindles will have their rotation accelerated relatively to the motion of the carriage. These relative motions of the two racks, as described, are such as are required after the base of the cops has been formed, for then the threads are wound regularly on a cone; but in forming the base of the cops the first winding is on the naked spindles, at which time the motion of the spindles should correspond with that of the carriage; and from the commencement until the base is formed, the accelerated motion should be gradually brought into play to give the conical form to the cops. This is effected by having the chain that winds on the wheel that turns with the scroll cam attached to a slide that works on a screw in a vibrating arm, the outer end of which is jointed to another arm of equal length that turns on the end of the stud on which the scroll cam and wheel turn, so that when the slide is at the lower end of the arm—the two arms being of equal length—the motion of the wheel with the rack will not cause it to wind up the chain, but, as the slide is drawn up towards the axis of vibration of the arm, one end of the chain will necessarily move through a less space than the other, and thus cause the wheel with the scroll cam attached thereto to turn on its axis, and thus to vary the motion of the top rack, and thereby adapt the motion of the spindles to the varying diameter of the base of the cops. The screw in the vibrating arm that carries this slide is in connexion, by means of appropriate cog wheels, with a horizontal ratchet wheel, which is free to move when the arm vibrates in one direction, but held by the hand or catch when the arm vibrates in the reverse direction, for the purpose of turning the screw to move the slide; and this hand or catch is governed by an apparatus called a butterfly, which is acted upon by an arm from the counter faller when the tension of the threads is too great, and thus throws the hand into the teeth of the wheel, that the vibration of the arm shall operate the slide, the hand or catch being disengaged at each running out of the carriage. The last of the third series of motions is the operation of the coping rail for operating the faller, which, being essentially similar to others, needs no special notice here.

"At the end of the running-in motion of the carriage, a pin, on an arm projecting from the shaft of the crank that operates the under rack, liberates the catch that holds the connecting rod, by which the backing-off motion is effected; and so soon as it is liberated, the weight of the machinery attached draws it back; and to prevent any sudden jar by this operation, the crank pin which operates the connecting rod in one direction is so governed in its revolutions as to be nearly a semi-revolution from its point of departure at the commencement of the backing-off operation, so that the force required for carrying it back to this position is sufficient to ease off the motion of the returning parts. This crank pin is held in the position just indicated by a brake within the second fast pulley, and this brake is connected, by a joint link and lever, with the arm of the connecting rod of the backing-off apparatus, which, when drawn back, forces the brake in contact with the pulley, and arrests the train of wheels and this crank pin in their appropriate place.

"When finishing the cops, it is important to wind the threads on tight at the point, particularly as the upper ends of the spindles are tapering. This is effected by forming the connexion between the chain and the end of the top sliding rack by means of a vibrating frame, from which projects another arm, that has a chain jointed to it extending to and winding on an arbor, which arbor has a ratchet-wheel on it, which is carried a part of a revolution at each operation of the mule by a hand on the arm of the connecting rod of the backing-off motion; and this auxiliary chain is of such length that it continues to be wound upon the arbor without affecting the operations of any part of the machinery until the cops are nearly completed, and then it becomes so short as to be brought in contact with a permanent arm towards the end of the winding-on operation; and when thus brought in contact with this arm, it suddenly shortens the chain that forms the connexion between the two racks, and necessarily increases the rotation of the spindles, which, as a necessary consequence, draws the threads tighter on the spindles."

Claim.—"I have thus described the general character of my invention, and the manner of constructing and using the same; but before pointing out what I claim as my invention, I wish it to be distinctly understood that I do not limit myself to the precise form and construction of the various parts employed, nor to the precise arrangements described, as I consider all mechanical equivalents as within the limits of my invention; what I claim, therefore, as my invention, and desire to secure by letters patent, is—

"1st. The disconnecting of the mechanism employed in running out the carriage and turning the draw rollers from the mechanism, which gives the whirling or spinning motion to the spindles when the driving power is shifted from these, the first series of motions, to enable the spindles to continue their motion by inertia, independent of the other motions, by means of the clutch box, (or its equivalent,) which forms the connexion between the three movements constituting the first series of motions, whereby the momentum of the spindles can be employed for preparing the parts for the backing-off motion, substantially as described.

"2d. The method of preparing the parts for the backing off motion, by means of the momentum of the spindles, by connecting them with the backing-off apparatus by means of the friction clutch, or any equivalent therefor, substantially as described.

"3d. The backing-off apparatus, consisting of the combination of the top sliding rack, which communicates motion to the spindles; the rocking shaft, with its cam and spring brake, and other appendages, and the connecting rod, operated by the crank; all substantially as described.

"4th. The method of decreasing the backing-off motion to correspond with the increased length of the cops, by means of the slide in the intermediate arm of the connecting rod, (between the two sections of the connecting rod,) by means of which the rocking motion of the rock shaft is gradually decreased, substantially as described.

"5th. Combining the train of wheels which actuate the backing-off motion of the carriage by means of a clutch, substantially as herein described, which admits of the necessary backing-off motion before the tooth of the clutch starts the carriage, whether this be effected by a clutch, or by any other means, substantially the same.

"6th. Running in the carriage by means of a crank motion, which actuates a sliding rack that communicates the desired motion to the carriage, so as to start and arrest it gradually, substantially as described, to avoid any sudden strain or jar upon the threads.

"7th. The method of communicating the winding-on motion to the spindles from the main rack, which runs in the carriage, by combining the said main rack with the top sliding rack by means of a chain and scroll cam, or their equivalents, by means of which combination, in connexion with the form of the cam, the motions of the spindles so correspond with that of the carriage as to wind the thread on the conical forms of the cops, as described.

"8th. The method of varying the winding-on motion of the spindles, to form the base of the caps, by means of the slide and chain, which vary the motions of the wheel that is attached to and which rotates the scroll cam, substantially as described, whether the slide be operated by the vibration of the arm on which it slides, or by any other means, substantially as herein described.

"9th. The method of regulating the motion of the slide that varies the motion of the scroll cam of the winding-on motion, by means of what is termed the butterfly and its appendages, when this is acted upon by the counter faller, operated by the tension of the thread, substantially as described: and

"10th. The method of winding-on the threads tighter at the points of the cops, when finished, than by means of the apparatus which gives to the top sliding rack an increased motion towards the end of the operation; the said apparatus consisting of a chain, which is connected with the chain that forms the connexion between the main and top rack, and which is gradually wound up, and strikes against an arm towards the end of the operations of the mule to shorten the connexion between the two racks, and thus increase the winding-on motion of the spindle, as described."

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2. For an *Improved Self-Feeding Straw Cutter;* James T. Wade, Augusta, Georgia, October 3.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the brushes with the gauge boards, vibrating frame, and cutting blade, substantially in the manner and for the purpose herein set forth."

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3. For an *Improvement called "the Inclined Piston;"* James Richards, New York, October 3.

Claim.—"What I claim as new in my invention, and desire to secure by letters patent, is the use and application to pistons of the three or more inclined elastic wings, breaking joints, and fitted to each other as described, of cast iron, or any suitable material, working out the principle I have above mentioned, and combined together, and with a piston bulkhead and follower, or any substitutes for them, and working together in manner substantially as above set forth and made known."

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4. For an *Improvement in Looms for weaving Ribbons, and other narrow stuffs;* Carl V. Ganahl, (assignor to Francis V. Ganahl,) Junsbruck, Austria, October 3.

The patentee says, "The nature of my invention consists in constructing a loom for weaving ribbons and other narrow goods, which can be driven with great rapidity, by steam or other power, requiring only one person to tend 20 to 50 stands, all of which are driven by one axle, as there is a regulator and stop attached to each stand."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, the pickers constructed as above described, and also their combination with the lathe, in the manner and for the purpose herein set forth.

"Secondly, I claim regulating the take-up motion, by means of a roller which rests against the cloth beam, acting on an upright rod, with a gauge thereon to curtail gradually the motion of the pawl, and thus decrease the distance the cloth beam turns as it enlarges, constructed and combined substantially as herein made known.

"Thirdly, I claim the combination of the jacquard, constructed as above described, with the upright rods, in the manner and for the purpose before specified.

"Lastly, I claim the apparatus for stopping the loom—that is to say, the forked lever, arms, eccentric, hook, catch, and upright bar—constructed and arranged as herein described, in combination with the shipper for casting off the belt and stopping the loom."

5. For an *Improvement in the Glass Furnace;* Deming Jarvis, Boston, Massachusetts, October 3.

Claim.—"What I claim as my invention and improvement, is extending the fire-place and flame chamber entirely around, and so as to encompass the melting pot, in the manner substantially as above described, instead of placing the fire-place entirely on one side of the pot, as is the custom in ordinary glass furnaces."

6. For an *Improvement in Threshing Machines;* Walden Eddy, Duchess county, New York, and John A. Toplin, Washington county, New York, October 3.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the mode of inserting the teeth in the cylinder to threshing machines, in combination with the manner of making the threshing cylinder in several sections of cast iron heads, the whole constructed and operating in the manner and for the purpose herein before described."

7. For an *Improved Stove for Cooking and Warming Apartments;* Adam C. Conde, Schenectady, New York.

The patentee says,—"My stove, in its general construction, is similar to many other cooking stoves. It has two ovens, one of them placed above the other, with a flue space between them; but this flue space, and one in front of the two ovens, and at the back of the upper oven, do not admit any portion of the draught from the fire chamber, but used for the passage of air that is heated by the action of the fire through the back plate of said fire chamber, and the air so heated is to be subsequently conducted through suitable tubes to the apartments which it is desired to heat. The draught direct from the fire is conducted to the exit or smoke pipe, through flues especially appropriated to that object."

Claim.—"Having thus fully described the manner in which I construct and arrange the flues of my air-heating stoves, what I claim therein as new, and desire to secure by letters patent, is the particular manner of arranging the air-heating flues in front of, between, and behind the ovens, in combination with the flues for carrying off the gaseous product of combustion, the whole arrangement and combination being substantially the same with that herein made known."

8. For an *Improved process and apparatus for the Manufacture of Lenses;* Henry M. Paine, North Oxford, Massachusetts, October 3.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is, first, the combination of the furnace and fusing oven, in the manner described.

" Second, the construction of the "curvator," with its guides, substantially as herein set forth.

" Third, the process by which any required parabolic form or curvature may be given to the lens, as herein set forth in detail."

9. For an *Improved machine for cutting Laths;* James M. Winslow, Campbellsport, Ohio, October 3.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the manner of arranging the bearings of the feed roller in plates fastened to the outsides of the central posts, in combination with the revolving pointed feed roller, eccentric rack, and revolving pinions, for raising and feeding the logs to the knives."

10. For an *Improved Stock, for the neck;* Charles Fanshaw, New York, October 3.

Claim.—" What I claim as new, and of my invention, and desire to secure by letters patent, is the introduction and application of an elastic, metallic, or other band, to a stock frame for the neck, for the purpose as herein substantially set forth."

11. For *Improvements in the Manufacture of Gas;* George Michaels, Paris, France, October 3.

Claim.—" Having thus described the invention, and the best means I am acquainted with for performing the same, I would have it understood that what I claim is the hereinbefore explained improvement in the manufacture of gas from anthracite or other equivalent, for the purpose of lighting or heating; the same consisting in the employment of a *closed* furnace, (constructed and combined with a gasometer, as described,) and streams or jets of heated steam and air forced into the charge thereof in a state of combustion, all in the manner as above specified.

" I also claim the peculiar manner of increasing the illuminating power of the gas, (generated as above,) through the agency of oil or turpentine, or other equivalent matter, by causing the gas to pass through the olefiant fluid, and be impregnated by it essentially as set forth."

12. For *Improvements in the manufacture of Sugar from Cane or other Plants;* George Michaels, Paris, France, October 3.

Claim.—"Having thus described my discovery, I shall claim my heretofore specified improved manner of preparing the canes or saccharine plants, treating them and extracting the sugar by dissolution; the same consisting in cutting the canes or plants transversely through their saccharine cells, and into very thin slices, immersing them in hot water, and rendering insoluble and inert, during the process of dissolution, such chemical substances of the cane as would otherwise exert an injurious influence or chemical action upon the saccharine matter.

"I shall claim the use of oxalate of alumina, as above set forth, for the purpose of exerting the necessary chemical action upon the aforesaid combination of sirop; chlorophyle, and the superabundance of lime, in order to remove these two substances, and particularly the lime, that extraneous chemical matter used to render inert these substances, which would otherwise prove injurious to the sugar during the process of its dissolution from the cane, as described."

13. For *Improvements in Clocks;* John M. Schrock, Millersburg, Ohio, and John G. Fischer, Quincy, Illinois, October 3.

We omit the claim, because of its dependence on the drawings.

14. For an *Improved Machine for Gathering Fruit;* William Sedgwick and John Brooks, Poughkeepsie, New York, October 3.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the elastic fingers and sliding ring, arranged and operated in the manner and for the purpose set forth, whether constructed precisely in the manner described, or other mode substantially the same. Also, a pair of shears or cutters attached to the instrument on the top, or otherwise placed, for the purpose of cutting off the stem of the fruit if desired; said shears being closed by the closing of the elastic fingers. Also, the flexible hose for conducting the fruit, as set forth, in combination with the apparatus for gathering it, operated in the manner set forth."

15. For an *Improved Crimping Tool, for crimping boots;* William Taylor, Berlin, New York, October 3.

The patentee says,—"The nature of my invention consists in causing the leather to conform to the shape of the crimp, by forcing the latter, after the leather has been applied thereto, between two smooth iron jaws of peculiar shape, the interval between said jaws being regulated by a screw; a second screw acting against the heel of the crimp, and serving to thrust the instep thereof, and the parts adjacent thereto, between the jaws, as before mentioned."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the adjustable metallic jaws attached to the iron bars connected with the cross head, with the follower actuated by a screw passing through the cross head, and serving to thrust the crimp, with the leather thereon, between said jaws; the whole forming a hand tool, and being constructed and operating substantially as herein described."

16. For an *Improvement in Straw Cutters;* William J. Rylander Columbus, Georgia, October 3.

The patentee says,—"The nature of my invention consists in forming and hanging the knife of a straw cutter so as to cut with a diagonal down stroke, across the box, giving the most effective application of the knife to the purpose for which it is designed."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the knife, constructed in the manner described, in combination with the manner of working the same, so that it shall cut down across the box with a diagonal drawing stroke, as above set forth."

17. For an *Improvement in Carriage Steps;* David and E. Z. Little, Gettysburg, Pennsylvania, October 7.

The patentees say,—"The nature of our invention consists in causing the steps to be swiveled round under the carriage when folded up, out of the way of the mud and dirt thrown from the wheels, and without turning them up inside of the carriage."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is constructing the steps and attaching them to the body of the carriage, in the manner described, so as to allow them to be twined under the body when not in use, and held in either position, as described."

18. For *Improvements in Fire and other Engines for throwing water;* Charles W. Grannis, Persia, New York, October 7.

The patentee says,—"It is well known that in fire and other engines for throwing water, the air vessel into which the water is forced on its way to the discharge pipe, for the purpose of equalizing the discharge, by the elasticity of the air contained, is liable to a serious objection, viz:—that of mixing the air with the water, which causes the column of water to break into spray on leaving the discharge pipe, and that if the engine be kept at work for any considerable length of time, all the air is discharged from the vessel. This defect arises from the imperfect manner in which the air vessel is connected with the cylinder and discharge pipe, in such manner that all the water has to be forced through the air vessel.

"The nature of my invention, devised for obviating this difficulty, consists in placing the air vessel of a double acting engine between the two branch pipes which form the connexion between the two ends of the cylinder and the discharge pipe, and connecting the air vessel with them by means of pipes inclining upwards from the air vessel to the branch pipe, or rather inclining in the direction of the discharging current, by means of which that violent agitation which takes place within the air vessel on the usual plan, is entirely avoided, the outward current being without the vessel, whilst the body of air within the vessel is pressed on either side by the pressure of the water. This constitutes the first part of my invention.

"It is a well known physical law, that all fluids issuing from a vessel through an aperture, take a rotary motion, and hence the difficulty of throwing a solid unbroken column of water—a result admitted to be very important. This whirling motion of the water is necessarily due to the force applied, and by that much reduces the distance to which the column would otherwise be thrown. The object of my second improvement is to avoid this whirling motion, and at the same time save the power thus consumed, and consists in providing the bore of the discharging nozzle, or pipe, with wings parallel with, and converging to, the axis of the bore, whereby the column is divided into as many parts as there are wings, and the rotation of the water prevented."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is arranging the air vessel of double-acting force pumps between the two eduction or branch pipes, when the connexion is formed by means of two pipes, inclining from the air vessel to the branch pipes in the direction of the issuing columns, as described, whereby the discharge of air from the vessel is effectually prevented, and the elastic force of the air exerts a more direct force on the column of water at the end of the stroke of the piston than by any known arrangement.

"And I also claim the employment of a wing or wings within the bore of the nozzle or discharge pipe of fire and other engines for throwing water, as herein described, by means of which the whirling motion of the stream is prevented, and a more solid column obtained than by any other known method."

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19. For *Improvements in the Furnace for the manufacture of Articles of Iron;* William H. Passmore, Wayne, Maine, October 7.

The patentee says,—"For the purpose of heating scythes and other articles of a like character, up to the proper degree for hardening, the general practice heretofore has been to take them in their cold state and to pass them over the fire in a heating-furnace, constructed for that purpose, taking care to heat them as equally as possible in every part; but as scythes, swords, and other articles, having a cutting edge, are unequal in thickness, their thinner parts are the most quickly heated, and are liable to be injured from this cause before their backs or thicker parts are sufficiently heated for hardening. To guard against this result it has been necessary to heat them slowly, which is necessarily attended with much loss of time, whilst after all the evil is but partially corrected. In my improved heating furnace, I employ a case or oven of cast iron for the purpose of heating the scythes or other articles, previously to their being passed over the fire in the ordinary heating furnace; and in this case or oven I bring them to such a degree of heat as will enable me to complete the heating in the ordinary furnace with great rapidity. As the preparing oven contains a considerable number which are necessarily placed within it, they have ample time to allow their thicker and thinner parts to be brought up to the same degree of heat."

Claim.—"Having thus fully described the construction of my improved furnace for heating scythes and other articles to be hardened, what I claim therein as new, and desire to secure by letters patent, is the combination of the preparing case or oven with the heating furnace heretofore employed with said preparing oven, being formed and combined with the furnace, substantially in the manner and for the purpose set forth."

20. For a *Machine denominated a "Rotary Curve," to be used in constructing Cisterns;* Orlando Owen, Burlington, Vermont, October 7.

The patentee says,—"The usual mode of building cisterns is to form an inner and outer curve or mould of wood (the outer one extending only to the top of the cylindrical part of the cistern) with the space between equal to the thickness of the wall, which is formed by pouring in small stones and hydraulic cement until it reaches the top of the outer curve, it is then carried for a short distance on the top of the inner curve to narrow the opening, and the whole suffered to dry, which necessarily takes much time, as the curves exclude the air and the cement dries very slowly; but when it is dry the inner curve can only be removed by breaking it to pieces. The object of my invention is to avoid this inconvenience and to save much of the time required for drying the wall, and this I effect by means of a segment curve attached to one end of an arm connected with a central standard, in such manner that it can be moved around the standard, and carried up and down and inclined to form the top—the arm being made in two parts that slide on each other, to adapt the segment curve first to enable the operator to trim the hole in the earth to the required diameter for the outside of the cistern, and then to the inner diameter thereof. The two parts of the arm slide on each other, and can be secured at any desired point by means of a set screw, and it is connected with the central standard by means of a ferule, to which it is jointed, which ferule can be held at any desired elevation by a pin passing through holes in the standard; and for the purpose of giving the arm any desired inclination, it is mortised and plays on a sector attached to the upper part of the ferule, and provided with holes and a pin."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the segment curve with the arm, ferule, and standard, for the purpose and in the manner substantially as described, and these thus combined also in combination with the sector for forming the arched top of the cistern, substantially as described."

21. For an *Improved Washing Machine;* H. B. Masser, Sunbury, Pennsylvania, October 7.

The patentee says,—"The nature of my invention consists in carrying the whole body of water in the machine up to one end, where it is allowed to percolate through the clothes, and thus wash them without pressing or rubbing them, by simply forcing the water through the clothes, by which much labor is saved and the clothes washed without wearing."

Claim.—"Having thus fully described the nature of my invention, and shown the operation thereof, what I claim therein as new, and desire to secure by letters patent, is the combination of a dasher having a valve therein, as above described, with a wash board and side pieces, so arranged as to allow the water forced up by said dasher in front to pass behind the same, substantially in the manner and for the purpose set forth."

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22. For an *Improved Engine, Operated by the Explosion of Gases;* Stuart Perry, New York, October 7.

The patentee says,—"My first improvement consists in surrounding the cylinder of the engine with water, to carry off the heat generated by the explosion of the gases, and keep it at a sufficiently low temperature for the efficient action of the engine, and at the same time in certain cases to employ this surrounding water, as a water bath, for the retort which generates the inflammable gas, when the gas is generated from a liquid or liquids, the heat generated by the combustion of the gases being sufficient to keep the water at the temperature required for generating the gas, whilst the water carries off the heat from the cylinder to prevent its being overheated. My second improvement consists in lubricating the piston and the inside of the cylinder with water, which not only prevents the wear of the parts, but at the same time aids in preventing these parts from being overheated. My third improvement consists in lubricating the piston rod, and preventing it from being overheated, by surrounding it with water, at or near the stuffing box. My fourth improvement consists in a new method of inflaming the gases, by platina heated by the heat of inflamed jets of gas and air from the retort acting thereon, the platina being so situated as to communicate by a valve or valves directly with either end of the cylinder, or with the passages through which the mixed gas and atmospheric air pass to either end of the cylinder. And my fifth improvement consists in the employment of a receiver containing condensed atmospheric air for starting the engine, in combination with another receiver, and with an air pump, by means of which atmospheric air is forced for the continued working of the engine, the said air pump being operated by the engine."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, surrounding the cylinder and induction passages of an engine, operated by the explosion of gases with water, for the purpose of keeping it at the requisite temperature as described; second, cooling and lubricating the inside of the cylinder and piston of an engine, operated by the explosion of gases by injecting water within the cylinder, whether this be effected in the manner herein described, or in any other manner producing the same effect as described. Third, cooling and lubricating the piston rod and stuffing box of an engine, operated by the explosion of gases, by injecting water around the piston rod and within the stuffing box, substantially as described. Fourth, the method of inflaming the explosive mixture in the cylinder, or in the induction passages, by means of heated platina, or other metal having like properties, and provided with a valve or valves, by which the heated surface can be separated from the explosive mixture, substantially as described. And, fifth, the combination of a receiver of condensed air, filled by an auxiliary force, with the receiver, into which air is forced during the action of the engine, as described, for the purpose of starting the engine as described."

23. For an *Improved Fire Grate for Heating Apartments, &c.;* John Goldenburgh, Cincinnati, Ohio, October 7.

The patentee says,—"The nature of my invention consists in causing the smoke, &c., from a fire grate constructed in the ordinary way, to descend on each side of the said grate in a line parallel with the front thereof, and thence return up and pass out of the chimney, thus heating a broad space on each side of the fire chamber or grate and economizing the fuel,—the draught in said flues being regulated by dampers placed just below the return, which when open will admit a sufficient quantity of air from the room to the flue, to check the draught through the fire in any desirable degree."

Claim.—"Having thus fully described my improvement, what I claim therein as new, and desire to secure by letters patent, is the combination of the dampers with the descending flues behind the front plate, and dampers connected with the grate, the whole being constructed and arranged substantially in the manner and for the purpose set forth."

24. For an *Improved Coupling for Railroad Cars;* James A. Cutting, and George Butterfield, Boston, Massachusetts, October 7.

The patentees say,—"The nature of our invention consists in coupling the cars to the locomotive and tender, and to each other, in such manner, as that the elevation or depression of the locomotive above or below the line of the rails, will disconnect the locomotive and tender from the cars attached to them, and at the same time disconnect the cars from each other."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the manner in which we connect and disconnect a car to and from the tender of a locomotive by means of the jaws, the connecting tongue, the sliding gate, the lever and fulcrum arm, combined and operating substantially as herein set forth. We also claim the manner in which we connect the sliding gate of the coupling apparatus, between the tender and the foremost car, to the sliding gates of the coupling apparatus between the remaining cars of the train, by means of the lever, the roller shafts, the connecting rod and lever, combined and operating substantially as herein described and represented."

25. For an *Improved Method of Moulding for Castings;* Francis N. Still, Buffalo, New York, October 7.

The patentee says,—" The nature of my invention consists in using two patterns for one casting, and having those patterns placed with the reversed sides up, and made stationary in two separate flasks, filled with plaster of Paris; my object in using two patterns, is that I may mould from concave and convex patterns, such as cannot be divided or moulded from a plate; my object in using the two flasks of plaster of Paris, is that I may get two concave and convex surfaces to fit each other perfectly, and at the same time fit the particular shape of the patterns, so that when a flask of sand is filled upon each of them, taken off, and closed together, it will form a perfect mould from said patterns."

Claim.—" What I claim as my invention, and desire to secure by letters patent, is making the second pattern or patterns by taking an impression of the first upon plaster of Paris, or other similar substance, and placing duplicate patterns in the cavities made by the patterns of the first, substantially as herein described.

" I do not claim moulding from plain patterns, such as can be divided and moulded from each half, nor from such as can be moulded in connexion with a plate."

26. For an *Improved Cooking Stove;* William B. Treadwell, Albany, New York, October 7.

The patentee says,—" The object of my invention is to throw the heated current from the fire box *directly* upon the *rear* boilers, and before its heat has been reduced by passing around the oven."

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the dividing the space between the top of the oven and the top plate of the stove into two distinct and parallel flues, by means of the horizontal partition plate, the upper flue communicating directly with the smoke pipe, and the lower connected with the fire-box by openings governed by dampers; the whole being constructed and operating as herein described and represented."

27. For an *Improved Machine for Shelling Corn;* James Murray, Baltimore, Maryland, October 7.

The patentee says,—" The part of the machine by which the shelling is effected is similar to some others which are now in use, consisting of a shelling wheel revolving vertically, having teeth on each of its sides that operate on the ears of corn which are fed in vertically through feeding troughs constructed in the usual manner. With this I have combined an apparatus for separating the grain, the cobs, and the dirt or chaff from each other, without the use of a fan wheel or other blowing apparatus. This has been heretofore attempted, but it has not been effectively accomplished, owing to the great force with which the grain, cobs, and chaff, are projected in all directions in the rapid operation of shelling. My improvement consists in the manner in which I combine guards of leather, or of other flexible material with the feeding trough and with the separator or screen, so as to arrest the force of the flying particles, and to prevent their insinuating themselves between the vibrating screen and the body of the machine, which if not prevented, will quickly obstruct the motion, and finally arrest it altogether."

Claim.—"Having thus fully described the nature of my improvement in the machine for shelling and cleaning corn, what I claim therein as new, and desire to secure by letters patent, is the employment, in the manner set forth, of the guards of leather or other flexible material, for the purpose of preventing the escape of the corn with the cobs, and the choking of the machine by the insinuation of chaff and dirt into the moving parts thereof."

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28. For an *Improved Machine for Shelling Corn;* Jonathan W. Gordon, Jamestown, North Carolina, October 7.

The patentee says,—"Tho nature of my invention consists in a revolving screw-formed sheller having a stationary holder through which the ear of corn is drawn by the screw, said holder preventing the ear from turning while being shelled by the fire."

Claim.—"Having thus fully described my improvement, I wish it to be understood that I do not claim a revolving tube armed with teeth on the inside for shelling corn, as that has before been done; but what I do claim as my invention, and desire to secure by letters patent, is the revolving spring arms, having segments of screws on their ends for drawing in the cobs through, and teeth for shelling the corn from the cob, in the manner described, and in combination therewith the jaws for holding the ear of corn to prevent its turning while being shelled, as described."

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29. For a *New and Useful Electrical Conductor;* Réné L'Angais, Paincourtville, Louisiana, October 7.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing the glass isolators with shoulders and cylindrical recesses, in the manner and for the purpose above described, in combination with the frame and rod, constructed as above set forth."

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30. For an *Improved Lantern for the Destruction of the Bee-Moth, and other Night-flying Insects;* Samuel C. Wilt, Hartleton, Pennsylvania, October 7.

The patentee says,—"The nature of my invention consists in the combination of a lantern provided with a surrounding open basin filled with oil or any other fluid, for the purpose to drown and destroy such night-flying insects which may be attracted by the bright shine of the light or candle."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the lamp with the surrounding funnel-shaped glass case, in combination with the open reservoir or basin filled with oil or any other fluid, and the chimney which is inserted from above, with the cone, for the use and purpose to destroy bee-moths and other night-flying insects, as set forth in the specification."

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31. For an *Improved Revolving Axletree;* Isaac Slack, Avondale, Pennsylvania, October 10.

The patentee says,—"The nature of my invention consists in reducing the friction and steadying the wheel, by dividing the revolving axletree in two equal parts, (at the centre,) and joining them in an elevated position over the straight line of the centre of the wheels, by a tapering pin of the one axle in a straight hole of the other axletree—by this arrangement the spokes of the wheel receive the pressure perpendicularly."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is in particular the revolving axles, coming together, intersecting, and elevated above the straight line of the centre of the wheels, in combination with a straight hole in one and a tapering pin in the other, for the use and purpose as described in the specification."

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32. For *Improvements in Machinery for Drawing Water from Wells, and Raising Heavy Weights;* Harvey W. Sabin, Rushville, New York, October 10; antedated September 9, 1846.

The patentee says,—"The nature of my invention consists in raising weights, and in raising and discharging water from a well, by two alternating buckets, and regulating the height to which they are raised by a double windlass, or windlass in two parts, which can be clutched together, so as to allow the weights to balance each other for any distance required. In raising water by this method it is not necessary to touch the buckets with the hand, the object being accomplished by a crank windlass cord, or any of the usual ways."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is arranging the two ropes to wind on the drums or windlasses in opposite directions, when this is combined with one of the drums made to clutch and unclutch for the purpose of regulating the length of the ropes to suit the depth to which the buckets, &c., are to descend, substantially as described."

33. For *Improvements in Stoves;* Charles H. Rogers, and Samuel H. Hancox, Troy, New York, October 10.

Claim.—"What we claim, and desire to secure by letters patent, is the damper, &c., connected with the openings or passages for a draught of air to the fire and that which leads to the air-chamber, as by one operation to close the whole, or in part the one, and in corresponding proportion to open the other, in combination with the inside bottom plate and hot-air chamber and inside top plate therewith connected, for preventing condensation of steam and for preventing explosion; all as above specified and described."

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34 For *Improvements in the manner of Constructing Locomotive Steam Engines, with Six or Eight Driving Wheels;* Ross Winans, Baltimore, Maryland, October 14.

Claim.—"Having thus fully set forth the nature of my improvement, what I claim, and desire to be secured by letters patent, is the employment of wheels with chilled cast-iron flanches in combination with an engine having six or eight driving wheels, with axles parallel to each other, and accommodating itself to curves and turnouts, by way of the devices or modes herein described for that purpose, and having the power applied to all the axles, by connecting rods and cranks."

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35. For an *Improved process for toughening the Hull or outer covering of Wheat and other Grain, preparatory to converting the grain into flour;* J. W. Howlet and F. M. Walker, Greensboro', North Carolina, October 14.

The patentees say,—"The nature of our invention consists in passing the wheat or grain through a current or jet of steam, in any convenient manner, so that each kernel of grain shall be thoroughly acted upon by the steam, which gives to the hull such strength and tenacity that it is not pulverized by the action of the stones in converting the grains into flour, and thereby specking and deteriorating its quality, but is pealed off the wheat in large flakes."

Claim.—"The utility of toughening the hulls of the grain in some way previous to grinding, and also the difficulty of effecting this desideratum uniformly, is well known to practical millers. When grain is ground in too dry a state, the hull is so tender and brittle that a portion of it is pulverized and passes through the bolt with the flour, disfiguring its appearance, and greatly reducing its merchantable value. What we claim as our invention, and desire to secure by letters patent, is the method or process of toughening the hulls of wheat and other grains, preparatory to grinding, by the application of steam, substantially in the manner and for the purpose as herein set forth."

36. For *Improvements in the Machinery for "trimming" Brushes;* Benjamin Babbitt, New York, October 14.

Claim.—"It is not intended to claim any of the parts employed for these purposes, as all are in common use in various ways; but what I do claim as new, and desire to secure by letters patent of the United States, is the application of the two-edged knife, constructed and fixed to direct and act in conjunction with the vibrating knife, and gauge guides, adapted to the form of the brush, when employed for the purpose of trimming the faces of brushes; the whole arranged, constructed, applied, and combined, substantially as herein set forth and shown."

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37. For *Improvements in Machinery for Threshing Grain;* Clinton Foster and Levi Jones, Laporte county, Indiana, October 17.

Claim.—"What we claim as our invention, and desire to secure by letters patent, in the within described machine, is the operation of the teeth in the cylinder, for the purpose of removing the straw from the drum—each row by its own gravity sliding in the grooves, project the teeth far enough to catch the straw, which, by its revolution, is brought up over the cylinder, when they return by their gravity, and the straw is thrown from the machine."

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38. For an *Improved Annunciator, or manner of communicating with the different rooms of a hotel or other building;* T. D. Jackson and A. Judson, Rochester, New York, October 17.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the drops with the tumblers, drop-levers, and slides, substantially in the manner and for the purpose herein set forth."

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39. For *Improvements in the Saw Gin, for separating cotton from the seeds, and cleaning the fibres;* Peter Von Schmidt, Washington, District of Columbia, October 17.

The patentee says,—"The ginning of cotton with the saw gin has for a long time been attended with much difficulty, from the very nature of the fibre, its condition in the pod, and the operation of the instruments employed to separate the fibres from the seeds, to which they adhere with more or less tenacity, according to the quality.—These difficulties have led to many modifications of the gin, with the view to remedy the evils, but so far little improvement has been made in that most valuable of all modern inventions. The fibres are united to and surround the seed, forming pods, which contain motes, particles of dead leaves, and other foreign matter very injurious to the gin, and particularly to the staple when passing through the gin with the fibres; and the tenacity with which the fibres adhere to the seed, and to each other, renders it very difficult to separate them without either cutting or breaking them, or otherwise injuring them by abrasion. When the fibres are not properly loosened preparatory to their being drawn through between the ribs by the saws, they are liable to coil around the upper part of the ribs, and are there cut by the saws, and choke the operation of the machine. Again, after the fibres have been properly separated from the seeds, much difficulty has attended the removal of them from the teeth of the saws by the rotating brush, which, by the action of currents of air drawn on both sides of the gin by the rotation of the brush, force the fibres towards and clog in the middle, so that the action of the brush fails to act equally in removing them from the saws and from the bristles; and at no time does the brush comb out the fibres, and separate from them the foreign matter, which is always found with cotton in great quantities.

"The object of my improvements is to avoid these serious evils; first, by combining with the saws and ribs a rotating cleaner, consisting of one or two arbors placed parallel with each other, and provided with pins projecting therefrom radially, and playing between each other and between permanent teeth, so that by their rotation they act on the pods of cotton, loosen the fibres and separate from them motes and other impurities, which fall through the grated bottom of the hopper. From this cleaner, the cotton falls on to the saws, and is acted upon by the teeth; but if the pods are not sufficiently loosened, they are carried up and again acted upon by the cleaner, and thence again fall on to the saws. In this way the pods are not only freed from all impurities, but the fibres are sufficiently loosened to be separated from the seeds without injury to the staple or the liability of breaking the seeds, the particles of which, when carried through by the saws, are very injurious to the staple. Second, in making the upper surface of the ribs or grates between the saws without a double beveled surface, with a series of transverse projecting ridges from the bottom to the top, and also in having their lower ends attached to a hinged frame which rests on springs, the effect of which is that, as the pods are carried up from the bottom of the hopper, they strike against the projecting ridges or teeth, which causes them to roll up, at the same time giving to the ribs, in consequence of their spring attachment, a tremulous motion that greatly facilitates the action of the saw teeth on the fibres, as the pods are thus carried towards and from the teeth, which have the action of combs to loosen the fibres. Third, in providing brushes below the rotating brushes, and placed parallel with the axis thereof, and slightly inclined in the direction of the rotation, for the purpose of combing or brushing the fibres which are caught by the stationary brushes and acted upon by the rotating ones; and when properly brushed, and the motes and other impurities separated from them and discharged through a grating below, are liberated from these stationary brushes and delivered in the usual manner. And fourth, in providing the ends with spiral fans, which draw in a current of air from each end, and force it out by centrifugal action equally from end to end of the saw cylinder, to liberate the fibres from the brushes, and to generate an outward current to carry off the motes and other impurities below the stationary brushes and the concave, on to which the cleaned and brushed fibres are delivered."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, the cleaner, when placed in the hopper and forward of the saw, in combination with the gin saws and ribs, substantially as described, whereby the pods of cotton are loosened and the trash cleaned out, and the unginned pods that have been acted upon by the saws, are carried back to the cleaner, again to be acted upon by the teeth thereof, as described.

"Second, making the upper and outer surface of the ribs between the saws with a series of teeth, substantially as described, for the purpose of resisting the upward movement of the pods, and causing them to turn as they are carried up, as described.

"Third, attaching the ribs so as to vibrate at the top, on a hinged joint, when this is combined with a spring connexion at bottom, substantially as described, whereby they receive a tremulous or vibratory motion to carry the pods towards and from the saws, as described.

"Fourth, the series of permanent brushes below the rotating brushes, when combined with the rotating brushes and saws, substantially as described, for brushing the fibres, and more effectually removing the motes and other impurities therefrom, as described; and in combination with this, I further claim the grate and discharge passage for the motes and other impurities, below the permanent brushes, substantially as described. And, finally, I claim, in combination with the rotating brushes, the spiral or oblique fan blowers at each end, substantially as described, for the purpose of introducing within the brushes currents of air to discharge the fibres from the brushes, and to carry out the motes and other impurities, as described."

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40. For *Improvements in the Press for pressing Hay, Cotton, &c.;* Nicholas Lampman, Coxsackie, New York, October 17.

The patentee says,—"In the press patented by W. C. Van Hoesen, on the first of February, 1842, the progressive levers are attached to, and operate the follower, are worked by cords or chains attached directly to them, the lower ends of the levers being provided with rollers that run on the bed of the machine. If it be desired to apply a double purchase to these progressive levers, a pulley must be attached to each of them, around which to pass the ropes or chains, so that in addition to the friction of the rollers that run on the floor of the press, there is the friction of the pulleys, and the additional complexity of parts. The object of my improvement is to obviate this difficulty, and attain the desired end by making use of the rollers on which the ends of the levers run, to answer the additional purpose of pulleys, by making each roller with two treads, to run on rails, each tread having an inner flanch to guide it—and making a groove between the flanches, of the same diameter as the treads for the reception of the rope or chain, to avoid the slip of the rollers on the rails. This arrangement, in addition to the advantages above enumerated, admits of making the parts stronger, and of working the levers up to a vertical line, which cannot be done with the old plan, for the space which would be occupied by the windlass and the pulleys, with their attachment, would necessarily be greater than the space between the levers, where they are joined to the follower."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described of forming the connexion between the windlass and the ends of the progressive levers by passing the chains or ropes by which they are operated, around the rollers that run on the two rails, the treads of the rollers and the pulleys around which the chains or ropes pass being of equal diameters, to prevent slipping or bighting; all substantially as herein described."

41. For an *Improved mode of giving Feed to Saw Mills;* Nathan Compton, New Garden, Indiana, October 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the new and improved feeding hands, herein described, to saw-mills, acting laterally by a bight on the wheel, and insuring greater precision and regularity in giving feed to the saw."

42. For *Improvements in the Steam Engine;* N. N. Barlow, Homer, New York, October 21.

The patentee says,—"In the steam engine as now constructed, the piston must be accurately fitted to the cylinder, and packed; the cylinder is then provided with a head or cover, accurately fitted and bolted, and provided with a stuffing box around the piston rod; and then the end of the piston rod, where it receives the connecting rod, is either provided with a sliding head working on ways, or with a parallel motion, which are not only very expensive, but either of these modes occupies much room; for there must be, between the upper end of the cylinder and the beam or other connexion, room sufficient for the length of piston and connecting rods, which, in many instances, is a source of great inconvenience, as, for instance, in steamboats.

"Many of these objections I avoid, and render the engine cheaper and less liable to derangement, by making the piston a long hollow cylinder, the outer diameter of which fits, either accurately or loosely, the inside of the steam cylinder, the upper end of which is provided with a stuffing box which surrounds the hollow cylindrical piston: that is, therefore, made of greater length than the steam cylinder within which it works, thus avoiding the necessity of a packed piston. The inner end of this piston cylinder is closed to form the piston head, and to the inner surface of it is attached the connecting rod, which extends to the crank. By this arrangement, the unequal wear of the piston and cylinder by the vibrations of the connecting rod is avoided. The steam, of course, in this arrangement, can act only in one direction, and therefore will be only single-acting; but when it is desired to make a double-acting engine, then two such single-acting engines are so arranged as to be connected together by a crank shaft, having two cranks on opposite sides of the axis, so that the moment one ceases to act the other commences, the valves alternately opening and closing the induction and eduction valves.

"It will be obvious that this engine may be single-acting by having but one cylinder and its appendages; double-acting, as above described; threefold-acting, by having three cylinders with the cranks, making an angle of 120° with each other, so as to divide the circle into three equal parts, the threefold-acting being the best for working the steam expansively, by means of cut-off valves, as the steam will at all times be acting with its full force in one, and expansively in another.

"By constructing an engine on this plan, but one packing will be required for each cylinder, and that a stuffing box which admits of adjustment much more readily than a piston, which can only be repacked by taking the engine apart. It dispenses with the necessity of a sliding head or parallel motion, the cylindrical piston performing that office by having the connecting rod jointed to it within and at the bottom, at the same time saving the room occupied by the piston rod in the common engine; and what is of great importance, the piston can always be kept oiled by simply oiling the stuffing box, which is not the case in engines as heretofore made."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the pistons of steam engines cylindrical, and of sufficient length to work through a stuffing box around it, at the open end of the steam cylinder, substantially in the manner and for the purpose specified, in combination with the jointing of the connecting rod to the bottom thereof, for the purpose of saving the room occupied by the piston rod, the piston being guided by the stuffing box at the end of the cylinder, and preventing the upper edge of the piston from cutting the cylinder, as would be the case with a shorter piston, as described."

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43. For an *Improved Machine for Polishing and Finishing Cloth;* Josiah C. Carlisle, Armagh, Pennsylvania, October 21.

We are compelled to omit the claims of this patent on account of their reference to, and dependence on, the drawings.

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44. For *Improvements in the Manufacture of Cast Steel;* Josiah Marshall Heath, London, England, October 22; in England, February 4, 1846.

The patentee says,—"The process now universally in use for making cast steel is to reduce pig-iron of suitable quality into bars of malleable iron; to convert these bars into blistered steel, broken into fragments, in close crucibles; and to pour the fluid steel into iron moulds.

"The expense attending these different processes is enormous. If the cost of pig-iron of a quality suitable for good steel be £8 a ton, the cost of cast steel, in ingots, made from such pig-iron, by the usual process, will amount to upwards of £30, or four times the cost of pig-iron. I have discovered a process by which the conversion of pig into bar iron, of bar iron into blistered steel, and the use of crucibles for melting the blistered steel, may be dispensed with, and cast steel may be manufactured at a cost far below that of the old process.

"This is done by melting together a mixture of pig-iron and malleable iron in such proportions that the fluid mass arising from the mixture shall contain just that amount of carbon which, when combined with iron, forms steel.

"The process I now use is described as follows: The pig-iron to be converted into steel may be melted in a cupola, or it may be run direct from a blast furnace used for smelting iron ore; but the most suitable apparatus I consider to be a common cupola furnace, blown with hot air, in order that the metal, when run from it, may retain its highest possible temperature. The fluid pig-iron shall be run from a cupola or other furnace into a receptacle, made of any material capable of withstanding an intense heat, similar in form to a common refinery, or to the shallow well of a reverberatory furnace for melting pig-iron, and the quantity of fluid pig-iron used for one operation should occupy about one-third, or thereabouts, of the capacity of the receptacle. The interior of this receptacle and its contents should be kept at the highest temperature that can be produced; and I find a very ready and convenient method of producing this high temperature to be by currents of ignited carbonic oxide gas, conveyed through pipes placed round the top of the receptacle, slightly inclined downwards, so as to bear upon the surface of the fluid metal. A sufficient temperature for this purpose may also be produced by a current of oxy-hydrogen gas, produced by directing a stream of atmospheric air into a current of hydrogen gas, formed from the decomposition of water allowed to trickle upon malleable iron brought to a high heat. In order to burn the carbonic oxide, it is necessary to introduce along with it a current of hot atmospheric air; or, if a more intense heat is required, a current of oxygen gas. In either case, however, care must be taken that the proportion of atmospheric air, or of oxygen gas, does not exceed that which is required to convert the carbonic oxide into carbonic acid, as any excess of oxygen in the blast would have a most injurious effect upon the melted metal in the receptacle.

"The carbonic oxide may be obtained from the waste gas from the cupola employed to melt the pig-iron, or from a blast furnace, or it may be generated in a separate apparatus by the imperfect combustion of any fuel; and the application of it may be in any of the numerous and well known methods already in use. The proportion of hot atmospheric air, or of oxygen gas necessary to form carbonic acid, may be exactly regulated by means of stop cocks or valves in the pipes by which the hot air or oxygen gas is conveyed into the streams of carbonic oxide.

"In order to decarburate the fluid pig-iron in the receptacle to the degree necessary to form steel, I mix with it a certain portion of malleable iron, more or less, as I wish to make steel softer or harder; but for cast steel of a medium degree of hardness, such as is used for general purposes, I find that about equal proportions of pig and malleable iron answer best. The proportions in which the pig and malleable iron should be mixed, however, will much depend upon the quality of the former. If gray pig-iron is used, it will require more malleable iron to be mixed with it than if white pig-iron is used. This is a point, the exact determination of which can only be arrived at by testing the quality of the mixed fluid metal in the receptacle at intervals.

"The malleable iron to be mixed with the fluid pig-iron in the receptacle may be in scraps, or in any convenient form; but by far the most economical, convenient, and purest state in which the malleable iron can be used is in the granular form, produced by reducing any perfectly pure oxide of iron to small fragments, and then submitting them to the well known process of cementation in a common converting furnace, such as is used for converting bar iron into blistered steel. The iron ore in small fragments is mixed with just that proportion of carbonaceous matter which is sufficient to combine with its oxygen at a red heat in a close vessel; and when the process is finished, the malleable iron is obtained in the purest possible state.

"Before adding the malleable iron to the fluid pig-iron, the former must be brought to a white heat, and this may be done in a separate furnace; but I find the most convenient method is to place the malleable iron on a bed between the receptacle which holds the fluid pig-iron and the chimney up which the waste heat from the combustion of the gas passes. The malleable iron, when at a white heat, is raked into the receptacle containing the fluid pig-iron and the whole is kept in fusion and stirred about for a sufficient time to produce intimate mixture and uniformity of composition into the fluid mass; and when the assays taken from it show that the steel is of the desired quality, the contents of the receptacle are run off into moulds of any form or size required."

Claim.—"What I claim is the exclusive right of preparing cast steel by decarburating pig-iron to the degree required to form steel, by mixing with the pig-iron, run from a cupola or other furnace into a separate receptacle, malleable iron in the proportion necessary to form steel, and running the mixture of pig-iron and malleable iron, while still fluid and in the state of cast steel, into moulds from the receptacle."

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45. For *Improvements in the Mode of Constructing Pumps;* David Hinman, Brunswick, Ohio, October 24.

The patentee says,—"The nature of my invention consists in the manner in which I have constructed and connected the different castings of the double cylinder lifting and force pump, by which the parts are more conveniently and readily connected or disconnected, for repair."

Claim.—"Having thus fully described my improvements, what I claim therein as new, and desire to secure by letters patent, is connecting all the joints of a double cylinder force pump, substantially in the manner described, so as to hold them firmly together by means of one key, as above specified."

46. For an *Improved Compound Filter and Stop Cock;* William Read, New York, October 24.

The patentee says,—"My improvement consists in employing a case perforated at each end and containing sand or other filtering material which is received in an enlargement made in the stop cock between the valve and the delivery spout, which are made separate and screw on to each other at the enlargement, so that by unscrewing the delivery spout, the filter can be removed and taken out or reversed, and the spout screwed on again with or without the filter—that face of the enlargement which is connected with the delivery pipe being provided with leather or other packing, so that when the case of the filter is forced against this packing by the pressure of the column of water, it shall form a perfectly water-tight joint. And my invention also consists in making the case that contains the filtering material with a hole in its periphery provided with a screw-plug, through which the filtering material is introduced, or removed when it is required to be changed, when this is combined with a stop-cock, provided with an enlargement, such as above described, for receiving and removing the filterer."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is placing a filter in an enlargement or chamber of the stop-cock between the valve and delivery spout, when these are connected by screwing on each other, and provided with packing, so that the pressure of the column of water shall press the filter against it, and thus form a water-tight joint, all substantially as described, whereby the filterer can be removed or reversed for cleansing, and the stop can be used independent of the filter, as described."

47. For an *Improved "Pessary," for a "Prolapsus Uteri;"* Joel B. Merriman, Sheffield, Massachusetts, October 24.

The patentee says,—"The nature of my invention consists in making a pessary of glass or any other hard substance that might be used for like purposes, but I give a decided preference to glass, as it is much smoother and less liable to corrode than metals. It consists of a hollow cylinder or pipe about five inches long, a little curved to correspond to the natural passage to the uterus, the principal part of the curve being nearest to the upper part of the pipe, the upper end of said pipe is concavo-convex, and about two inches in diameter, the convex part being attached to said pipe, the concave surface being for the support of the uterus; the lower end of said pipe has a plano-convex basis about one inch in diameter, the convex part being attached to said pipe."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the attaching to the pessaries a curved inflexible tube, as set forth in the specification."

48. For an *Improved Boiler for the Heating of Tanning Liquids and other Fluids;* Warren Nims, Port Ann, New York, October 24.

The patentee says,—"In the process of tanning as now carried on, the tanning liquid, which has been allowed to act on the skins, until it is nearly spent, is reheated and made to act upon fresh bark, so as again to become saturated with tannin. My boiler has been constructed with a view to its application to the heating of such exhausted tanning liquids, but is equally applicable to the heating of liquids for a variety of other purposes. I construct a boiler of sheet metal in the usual way, and above this I place a reservoir or cistern, into which the liquid to be heated may be raised from a tan vat or other receptacle by means of a pump. From the bottom of this cistern a pipe descends and passes through the top of the boiler which is to be kept entirely full of the liquid. Below the boiler is a furnace or fire chamber in which wood is to be used as fuel: this fire chamber I divide into two compartments, the number may however be increased, but I deem two sufficient for all useful purposes. This division into compartments consists merely in a double tier of tubular grate bars to support the fuel. In the boiler that I have essayed, these tubular bars are about three inches in diameter; three, or any other preferred number of these are used in each compartment crossing the fire chamber from side to side. They are closed at their ends, and the liquid from the boiler is admitted into them through smaller tubes, say of one inch in diameter, which tubes may enter those which constitute the grate bars near their ends at each side of the fire chamber. The liquid which thus enters is not to be returned to the boiler, but is to be conveyed from the larger transverse tubes first named, into a tube which rises vertically at the rear end of the boiler to a height equal, or nearly so, to that of the top of the boiler, where it is furnished with a cock, by means of which the heated liquid is allowed to run off and be conveyed into a vat or receptacle, where it may be wanted."

Claim.—"Having thus fully described the manner in which I construct and manage the respective parts of my boiler and furnace for the heating of tannin or other liquids, and shown the operation of the same, what I claim therein as new, and desire to secure by letters patent, is the manner of combining the boiler (which is to be kept full of liquid) with the respective series of hollow grate bars, and with the delivery or discharging tube, by means of the series of smaller tubes, arranged and operating substantially as herein made known. I do not, of course, claim the use of grate bars, made hollow for the purpose of passing water or other liquid through them, this having been frequently done; but I limit my claim to the special arrangement and combination of the respective parts of my apparatus, by which it is adapted to the attainment of the end therein proposed."

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49. For *Improvements in the construction of Carriages for Railways;* William Coles Fuller, London, England, October 24.

The patentee says,—"My improvements consist, firstly, in placing a cushion at each end of a railroad carriage, and covering the whole or the greater part of each end of it, in such a manner that in case of a collision of a train, the cushions of the carriages may diminish the effect of the concussion, and tend to the security of the passengers. The second part of my improvements consists in the application of buffer springs of vulcanized India rubber or caoutchouc; and the third, in the forming of the springs that support the body of India rubber, in manner hereinafter described, for the purpose of promoting the ease and safety of the passengers, and the safety of the transit of goods."

Claim.—"Having thus described my invention, and the manner of carrying the same into effect, I would observe that ordinary India rubber is liable to be affected by changes of temperature, and to become hard or rigid by exposure to cold, and therefore I prefer to use India rubber or caoutchouc prepared with sulphur, in the manner described in the specification of a patent granted in the United States to Charles Goodyear, as caoutchouc thus prepared is not liable to be acted upon by any ordinary temperature to which it may be exposed. And I hereby declare that I claim as my invention—

"*Firstly*—The application of cushions to the ends of railway carriages, as represented, and hereinbefore described.

"*Secondly*—I claim the manner set forth of forming the buffers of disks of India rubber, with plates of metal interposed between them, as herein shown and described; that is to say, the metallic disk being made larger in diameter than those of the India rubber, for the purpose set forth.

"*Thirdly*—I claim the manner set forth of forming the carriage springs of long straps of India rubber, extending along between teeth, and substantially as described and represented."

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50. For an *Improved Swingle-tree for Carriages;* H. C. Wiatt, Weldon, North Carolina, October 29.

Claim.—"What I claim as new, and desire to secure by letters patent, consists in the combination of the swingle-tree, springs, catch, and key, arranged and operated substantially in the manner herein described."

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51. For an *Improved Apparatus for cutting Screws on the rails of Bedsteads, and tapping posts to connect therewith;* Joseph Guild, Cincinnati, Ohio, October 29.

Claim.—"Having thus fully described my improvements, what I claim as my invention, and desire to secure by letters patent, is the combination of a series of augers, in the manner described, by means of the connecting rod and bars, substantially as described, and connected with an apparatus for cutting screws on bedsteads, as herein set forth, and for the purpose specified, so that any required number of holes can be bored, and in the right position for the pins. Lastly, I claim attaching a cutter to the top for cutting the first turn of the thread from the nut, so as to allow the rail to enter the post up to the shoulder, as above specified; the whole being performed at one operation."

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52. For an *Improved Cooking Range;* Moses Pond, Boston, Massachusetts, October 29.

The patentee says,—"As the cooking ranges have heretofore been made, it is impracticable to have more than two boilers or boiling chambers, one on each side of the fire chamber, two lateral flues being arranged to pass around the boilers and communicate with the oven behind and above; and as it is very desirable to increase the capacity of a range by the addition of other boilers, I have made an improvement by which I effectually attain this important end; which improvement consists in the addition of two boiler chambers, one back of each of the side boiler chambers heretofore employed, and so separated from them by partitions and dampers, as to use only one, or both, on each side, at pleasure."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the additional boiling chambers with the front boilers, and elevated oven of cooking ranges, substantially as herein described, whereby I am enabled to increase the capacity of cooking ranges as described; and I also claim in combination therewith the additional side flues and dampers, by which the products of combustion can be made to circulate around the front boilers before passing to the additional boilers, substantially as herein described; thus affording the ready means of regulating the heat of the front boilers, as herein described."

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53. For an *Improved "Tailors' Measure;"* Benjamin G. Martin, Richmond, Virginia, October 29.

Claim.—"What I claim is the invention of a brass plate, graduated with slides, clamps, and graduated straps, that will enable me, by the aid of a tape, to take measures for garments, and determine the commanding points, with more accuracy than any with which I am acquainted; the plate and straps being applied as set forth in the specification."

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54. For an *Improvement in the construction of the Piano Forte;* John Schriber, New York, October 29.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction and arrangement of the cast iron ribbed plate A, having an adjustable screw for extending it, in combination with the bar B and set screw F, for giving the proper tension to the strings, made and arranged in the manner set forth.

"I also claim attaching the strings to the tuning pins below a concave rest plank, constructed and arranged in the manner set forth, in order to the effect above described.

"I also claim the manner of tuning the piano, by drawing the strings out of a straight line and into the cavity in the under side of the rest plank, as described. Also the combination of the key N, level O, and damper lever P^4, as described. I likewise claim making the sounding board in waving or serpentine lines, in the manner and for the purpose set forth."

SPECIFICATION OF AN AMERICAN PATENT.

Specification of a patent for a new method of treating Iron in the process of rolling or drawing, specially intended for Railroad bars and Locomotive tires, invented by HORATIO AMES, *of Falls-village, Ct., granted on the 29th day of July*, 1847.

We are induced to publish the entire specification and drawings of this invention, not only on account of the value and merit which it presents to our judgment, but because of the deep interest which must be felt in all such improvements by those who are engaged in the manufacture of iron, and in railroads. The great rivalship now going on in this country and in England, in the manufacture of iron, renders every improvement which looks either to the reduction of the cost of manufacture, or to the amelioration of the quality of the iron, of the highest importance. And as the cost of repairs on railroads arises in a great measure from the wear of railroad bars and locomotive tires, by exfoliation and splitting, any invention which promises to avoid this evil must be looked upon with interest. The invention in question has already excited a deep interest in England, where the inventor has secured it by patent. K.

To all to whom these presents shall come:—Be it known, that I, Horatio Ames, of Falls-village, town of Salisbury, in the county of Litchfield, and State of Connecticut, have invented a new and useful improvement in the process of working iron, and in the machinery therefor, and that the following is a full, clear, and exact description of the principles or character which distinguish it from all other things before known, and of the manner of making, constructing, and using the same, reference being had to the accompanying drawings, (Plate I.) making part of this specification, in which figure 1 is a plan of the machine; figure 2, a side elevation; figure 3, a longitudinal vertical section, taken at the line (X. X.) of figure 1; and figure 5, a like section, taken at the line (Z. Z.) of the same figure. The same letters indicate like parts in all the figures.

In the manufacture of iron, either by rolling or hammering, the fibres are all drawn longitudinally, which, for the rails of railroads, for the tires of railroad wheels, and for a variety of other purposes, renders it liable to break off in thin leaves or scales, or to split lengthwise—this state of things being very common in the two instances specified. The object of my invention is so to treat the iron, either in the original manufacture thereof, or afterwards, as to avoid this defect, and thereby render the iron for these purposes more durable, by laying the fibres in such form and direction, as to prevent it from scaling off or splitting. And my invention consists in twisting the iron in, or before, or after, the operation of rolling or hammering, so that the fibres shall wind around one another, in a manner somewhat similar to the fibres of hemp in a twisted rope or strand.

And the second part of my invention relates to the machinery by which I carry into effect my improved process, and consists in combining two or more sets of rollers, one or both of which are to be draw rollers, and one set turning in the usual permanent bearings, and the other set or sets working in a frame or chuck that rotates on an axis at right angles to the axis of the rollers, to twist the bar of iron between the two sets of rollers.

To enable any one skilled in the art to apply my improved process of treating iron, and to construct and use the machine which I have invented therefor, I will describe the mode of procedure which I have essayed, as well as the manner of constructing and raising the machine therefor. The bloom of iron, or a bar previously formed, is taken while in a heated state, and twisted while undergoing the operation of hammering, which may be done by securing one end of the bloom or bar in a clamp and rotating it while the hammer rests on the other end; or by securing the two ends in separate clamps and twisting one of them, or both, in opposite directions, until the required twist has been given, and then subjecting it to the operation of hammering. But when the bar is to be drawn by rolling, the bar is to undergo the operation of twisting while passing between the rollers, or after it has passed between one set, and before it passes between the second set; and when it is twisted on its way to the rollers, one end of the bar may be secured to a clamp, which is to be rotated as the bar passes between the draw rollers.

As the bars thus prepared are, in most instances, to be re-worked to receive the required form or forms, according to the purposes which they are to be applied to, it will be evident that they may be twisted as they pass from the hammer or the rollers, instead of giving the twist before the hammering or rolling; and to effect this, the end of the bar may be clamped as it leaves the hammer or rollers, and the required twist given; but it is better to give the twist before the iron has undergone the operation of rolling or hammering, as it is then more highly heated, and the fibres will not be so severely strained as they would be after the metal has been partly cooled.

When iron has been treated and worked according to this process, the fibres, instead of running in the bar longitudinally, in straight lines, will run in the direction of a helix, gradually approaching to a straight line from the circumference to the axis of the bar, so that when used for making tires, or for other analogous purposes, the bar will be prevented from splitting along its length by the tenacity of the fibres, which cross the bar in the direction of a helix, instead of the mere adhesion of the fibres together: and when used for the rails of railroads, or similar purpose, none of the fibres can be separated from the mass longitudinally, as heretofore, nor can the iron be stripped off in scales until they have been cut off on each side, for, by their direction, they pass diagonally from one side, over the surface, and down the other side, whereby they are completely tied together.

Of the Machinery for working Iron in accordance with the foregoing process.

In the accompanying drawings, *a* represents a frame properly adapted to the purpose, and *b b*, two grooved rollers, such as are used in rolling mills for rolling bars of iron—the groove in each being semi-circular, or nearly so, that the two together may form a cylindrical bar. These two rollers are placed one above the other, with their journals in appropriate boxes in the two standards, *c*, *c*. The shaft of the lower roller extends out beyond one of the standards, and is provided with a level cog-wheel, *d*, which mashes into a level pinion, *e*, on the main driving shaft, *f*, which turns the lower roller, to feed in the bar of iron, *g*—the upper roller being carried by the motion of the lower one. Just back of the first set of rollers above described, there is another pair, *n*, *n*, similar to the first, except that the grooves in them are smaller, to draw the iron slightly, after passing the first set—they are mounted in a hollow chuck or frame, *i*, on the forward end of a hollow shaft or mandrel, *j*, that has its bearings in two standards, *k*. *k*, and which is provided with a cogged pinion, *l*, the teeth of which engage with a cog-wheel, *m*, on the main shaft, by which the second set of rollers are made to rotate at right angles to their axes, and on an imaginary line passing through the bight of the two sets of rollers, and in the centre of the two holes formed by the grooves on the rollers at the bight of each set, the axis of the hollow shaft or mandril being in this imaginary line. Back of the clutch, and attached to the front face of the forward standard, *k*, there is a wheel, *n*, the cogs of which mash into the cogs of two pinions, *o*, *o*, on two short arbors, *p*, *p*, one on each of two opposite sides of the chuck, the other end of these short arbors being provided each with a short screw, *q*, the threads of which engage with the cogs of two pinions, *r*, *r*, one on the end of each of the rollers of the second set, so that the cog-wheel, *n*, being permanently attached to the standard when the hollow shaft with its chuck, and the second set of rollers, is turned, the two cogged pinions, *o*, *o*, travel about this wheel, which turns the arbors to which they are attached, in the direction of the reverse of the rotation of the chuck, and the threads of the screw in turn engaging with the cogs of the pinions on the shafts of the second set of rollers causes these to rotate on their axes, and in the same direction with the first set, and with a velocity relatively to the rotation of the first set, proportioned to the amount of drawing action which they are intended to exert on the bar that is to pass between.

In this way it will be obvious that, when the machine is put in motion, and a bar of iron fed in, it will pass between the first pair of rollers and be partly drawn, and then pass between the second pair, which having two motions, one on their axis, and another at right angles thereto, and on the axis of the bar of iron, it (the bar) will in consequence be twisted between the two pairs of rollers, and also drawn by them, and the fibres compressed.

From the foregoing it will be obvious that the extent of drawing action of either or both sets of drawing rollers, can be regulated at pleasure, by simply varying the size of the grooves and relative motions of the draw rollers on their axes, and their rotation on the axis of the bar of iron.

It will be equally obvious, that the number of draw rollers can be increased, without changing the principle of my invention. It is to be understood that the iron, when subjected to the compound action of drawing and twisting, is to be in a heated state, such as is practised by, and known to, iron-masters in the manufacture of iron.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, the method herein described of treating iron to increase its toughness or durability for certain purposes—such as rail-road bars and tires, &c.—by subjecting it, in a highly heated state, to the compound operation of drawing and twisting, substantially as herein described.

"I also claim in the machinery above described, giving to one set of rollers the rotary motion on their axes, and a rotary motion at right angles thereto, on the axis of the bar of iron, when this is combined with another pair of rollers that have simply a rotary motion on their axes, substantially as described, whereby the bar of iron, in a highly heated state, is drawn and twisted, as described."

BIBLIOGRAPHICAL NOTICE.

"*Chemistry applied to the Manufacture of Soap and Candles, by* Campbell Morfit; Philadelphia, Carey & Hart, 1847."

The rapid progress of chemical manufactures marks a new era in the history of the arts, due partly to the development of chemical science, and partly to the spirit of thorough investigation, which is unquestionably one of the most striking characteristics of the present period of the world's history. It is but about a century since chemistry as a science can date its birth, although the germ of its existence has been elaborating during a period of several thousand years. But during that century, such an astonishing impetus has it received, that it is now engaged in unfolding, or endeavoring to unfold, the most secret and invisible operations of nature, in the production and growth of living beings; in attempting what would have formerly been regarded as irreverent, to fathom the depths of vitality; nay, to trace it to its very source, if we may credit the fond dreams of some chemical philosophers. Since the history of the chemical arts keeps side by side with that of the science, although a little more tardy than the latter, it is a fair inference that their growth is due to the science; and in fact their history shows it to be so.

But while we take a pleasure in surveying the astonishing improvements which the useful arts are daily receiving, and thus increasing and spreading the comforts of mankind at large, we hail with greater pleasure the evidences of their constant and probable never-ending

Fig. 5.

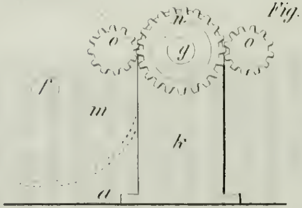


Fig. 4.

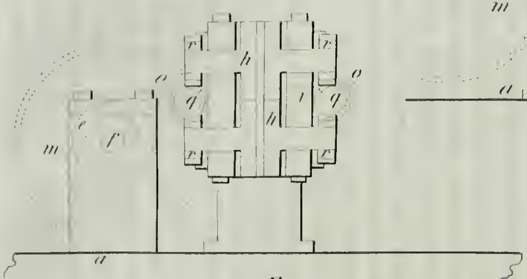


Fig. 3.

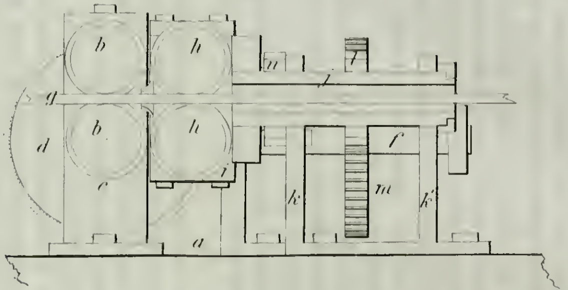


Fig 1

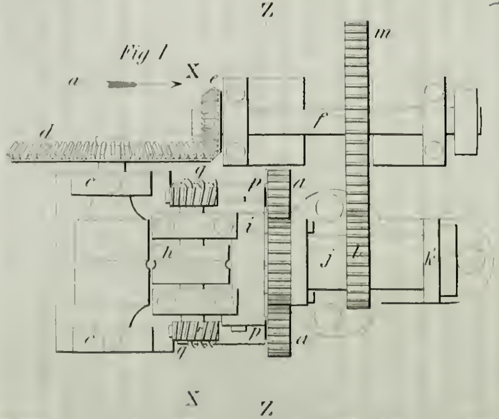
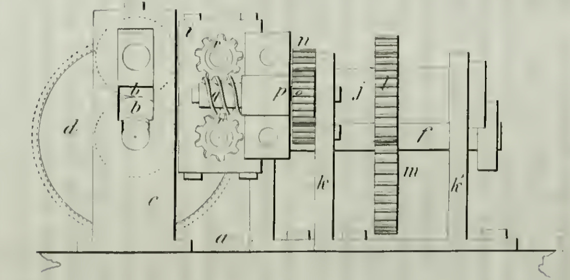


Fig. 2.



progress towards perfection in our own country. This progress has been most clearly shown by the public exhibitions of the products of American manufacture, which are provided at much care and cost by several institutions in the United States, and by none with more spirit and care than by the Franklin Institute. Among the signs of progress, we note with satisfaction many useful patents, taken out by citizens of the United States, both in this country and in England, for processes and apparatus which bear the stamp of novelty, ingenuity, and utility. We note, further, the republication of numerous and valuable practical works, originating in England, Germany, and France; and above all, we observe the issuing of original works amongst us, on various branches of the useful arts.

The title which heads the present article, is that of a work of the latter character, by an author who evinces both a practical and theoretical knowledge of the subject on which he discourses, and who, we know, has not even enjoyed the advantage of witnessing personally the state of the arts in Europe. Would that there were many more authors of such a stamp, who would not hesitate to communicate a portion, at least, of their practical experience in their several arts. Not that we would have them unfold to the public eye all their *arcana*, all the nice steps in their operations, upon which they have spent years of toil and much capital; for they deserve and should endeavor to draw pecuniary advantage from these, if practicable. But a large amount of valuable and available knowledge might be given to the public, and for the public good, without detriment to the authors, inventors, or artizans themselves. While the work before us unveils some of the hidden mysteries of one most useful branch of the arts, it withholds a portion, whose revelation might tend to the injury of those engaged in its practical details.

In calling this one of the most useful branches of the arts, we speak advisedly. So important was it considered near half a century since, that commissioners were appointed by the French government to investigate it; and now, so extensive are the operations connected with it as to involve millions of capital.

It is not necessary, on the present occasion, to refer particularly to the methods in use for cleansing purposes, previous to the introduction of soap. The soda of Egyptian lakes may have served very well in default of a better means, and some among us are retrograding to a period of 3000 years ago, by the employment of soda for washing and tearing textile fabrics. But we must allow much credit to the ancient Germans, who made known to the Romans, through the Gauls, the method of alleviating the destructive influence of alkali, by combining it with fat, without, at the same time, lessening its detergent qualities. The manufacture was nearly stationary during 1800 years; indeed we may say until chemical science first taught how to know the quantity of real alkali in the crude material, since the latter may have contained from 3 to 30 per cent., without the manufacturer's knowing well how to ascertain its richness. Then the brilliant discoveries of Chevreul, resulting from the laborious investigations of 10 years, (1813 to 1823,) in an almost untrodden field, gave the first clear insight into the *modus operandi* of the soap manufacture, as indeed they must be regarded as having laid the foundation and partly reared the superstructure of modern organic chemistry. The grand key to the progress of the chemical arts, was the improved method of making sulphuric acid, and in 1823 the cheapness of this acid originated the manufacture of soda from common salt. By action and reaction, both oil of vitriol and soda became cheaper from more extended use, and a few years ago 60,000 tons of soda ash were annually made in England, one-third of which, 20,000 tons, were employed in the manufacture of soap.

Not less remarkable has been the progress of the manufacture of materials for illumination, which has induced the like improvement in lamps and other apparatus for illumination. We are no longer content with the smoky blaze of a pine-knot, nor with the elegant form, but irregular and smoky flame, of an Etruscan lamp. We now strive to make the night rival the day in brilliancy, and that too, without any anxiety about showers of soot from a smoky flame. Chevreul's splendid discoveries of the composition of the fatty bodies, and of the properties of their constituents, almost immediately gave rise to the manufacture of stearic acid candles, which are now scarcely inferior to the choicest wax or spermaceti. The enormous production of lard in the United States, has induced an improvement in the manufacture of stearine, (the more solid portion of fat,) in which our author claims having taken a prominent part; nor are we disposed to deny his claim, having witnessed some of the progressive steps of his improvements.

In the book before us, we admire the typography, and the neatness as well as accuracy of the wood-cuts, of which the number, 170, shows that neither pains nor cost has been spared to render it most useful to the artizan. A pictorial representation of apparatus speaks more intelligibly to the understanding than the most labored and voluminous description; and works of this kind demand a liberal combination of both. The style of writing is less commendable, betraying too little attention to this portion of an otherwise highly praiseworthy undertaking. It is not a sufficient extenuation of this neglect to say that it was written mainly for the artizan, for the latter can enjoy a good style, and if not, to put such in his hands tends to elevate his character.

Chap. xxxvi is devoted to Hydrometers and Thermometers, including a scale of Beaumè, compared with specific gravity, and a table of the centigrade and Reaumur thermometers, in degrees, compared with Fahrenheit's scale. Chap. xxxvii contains scales of weights and measures, the French and English being compared together. We cannot but think it advisable in all English works, excepting in a few particular cases, that all weights and measures should be given according to English or American standards, however defective the system may be; but this should be more especially the case in practical works, where many readers would lose much valuable information, from inability to make the requisite calculations for converting the number of one system into those of another. A glossary of scientific and technical terms, in the concluding part of the work, will be found both convenient and useful.

The work contains 544 pages, devoted to two subjects—the manufacture of soap and of candles, and embraces all the most important parts of these two allied arts, entering frequently into the minutest details of the processes. It commences very properly with so much of purely chemical theories and facts, as will enable the manufacturer to understand those processes, which too often depend on mere empirical rules. A few general principles of chemical affinity introduce the subject of the alkalies and acids employed in these arts. The vegetable fats are followed by volatile oils, wax, resins, and the animal fats and oils; and among these subjects are many processes for extraction, purification, and bleaching, which the manufacturer may find it to his interest to consult. The ultimate and proximate constituents of soap, and the theory of saponification, introduce the reader into the details of the manufacture itself—the whole embracing 150 pages. We find here detailed the composition and mode of making nearly 100 varieties of soap, from the most common rosin soap, to the most delicately flavored toilet soap.

We are certainly pleased with the manner in which the author proceeds, step by step, from the foundations of the art in chemical science, to the important practical processes; so that the manufacturer may give a reason for the numberless details which he pursues, and may be enabled on sure grounds to advance his art and improve his practice. If we should object to the arrangement, it would be to that which allows the essential oils, wax, and resins, to intervene the vegetable and animal fats; while these are so closely related on chemical grounds, that we cannot well separate them. But it must be observed that the mode of obtaining the vegetable fats, by expression, and in other ways, differs materially from that of preparing the animal fats; and that this part of the work is devoted to the methods of extraction and purification. To the vegetable fats are allied the vegetable essential oils, in reference to origin and partly to the mode of preparation; and the resins cannot well be separated from the latter. On the whole, therefore, the author's arrangement is the best. He has treated with some degree of fulness, the chemical properties of the fat acids and their compounds, and we commend this subject to the careful study of the manufacturer, believing that he will be amply repaid, both by improvement in his products, and by a remunerating return. If we have a wish on this subject, however, it is that the author had been still more full of detail on all the chemistry of saponification, for we are firmly persuaded that the most numerous and valuable improvements in this and other chemical arts, must arise from the inexhaustible spring of chemical science. It is true that some blame for this defect is due to the meagreness of our works on elementary chemistry; and we hope that the author may yet find opportunity to pursue theoretical investigations in a field where he seems to be at home.

Although we regret some trifling remarks by the author, on the tricks of trade and follies of fashion, in the chapter on "Toilet Soaps," yet we must also regret the existence of that sickly, insatiate taste of the public, that demands the constant invention of new names for the same thing. It is undoubtedly advisable to give a toilet soap the name of the perfume with which it is scented, but to call it the "Savon aux pensez-à-moi," or "Savon à l'étoile d'amour," merely to give it currency, is ridiculous in the extreme, and a slander upon the good sense of the public. A well made rose-soap, or almond-soap, will always meet with an equally good sale under its simple English name, as under a Gallic puff or English nonsense. A tasteful label and envelope may win the eye once or twice, but the use of the enclosure will soon tear off the flimsy veil, and expose the real quality of the article. We believe it to be to the manufacturer's own interest to make the label and envelope correspond in taste and cost with the material enclosed.

The second part of the book treats of the manufacture of candles, with a short introductory on the nature of an illuminating flame. The author has likewise here progressed from the consideration of the raw material, to the manufacture of the candle itself, without despising the humble *dip*, and has devoted a chapter to each kind, the stearic acid, stearin, sperm, wax, and fancy sorts. This portion of the work is much more fully illustrated than the former, by 139 wood cuts, many of them representing entirely new apparatus or arrangements. If we were to value any one part of the work more highly than another, it would be this second part, especially chapters xlvii, xlviii, and xlix, which contain a large amount of the author's own experience in the manufacture. We especially commend chap. xlviii, "on stearin," to the public attention, as conveying his important improvement in the preparation of a pure and hard stearin, well adapted to southern climates. Lard has become one of the most important products of the United States, being rendered in quantities greater than the demand for home consumption; and since it must be exported, it is useful to inquire what is its best form for the market. Potash cannot be obtained in very large quantities, and at low prices, especially in those sections of the country where lard is most abundantly produced, nor is it likely that soda will be manufactured largely for some years to come; so that soap is not likely to be the best form at present for exporting lard, or at least it cannot be sent forth in this state alone. It would be far better to convert a portion of it into stearin and stearic acid, and to export candles. When the manufacture of sulphuric acid shall be conducted on a more extensive scale in the West, then soda, soap, and stearic acid can be produced in sufficient quantities and at such prices as to command a large home and foreign market.

We cannot applaud the introduction of many French terms by the author, although some are rendered necessary, from the want of precise English terms corresponding to the former. We can by no means allow that *Savonnier* is preferable to *Soap-boiler;* for the latter being compounded of two words, the meaning of each of which is well known to English ears, conveys to us the nature of the art, and the business of the artizan, with far greater clearness and force than any foreign word can do, especially where, as in the present case, the foreign word gives no definite idea of the nature of the manufacture. Nor it is a sufficient apology to say that savonnier is used because the term soap-boiler rather derogates from the standing of the individual before the community. We must deny this as a fact, however the term may be construed by a part of the public. If the art be useful—if it demand skill in its execution—if it embrace chemical or mechanical science in its process—no one has a shadow of right to regard the art and its operatives other than as worthy of an honorable position in society. Even if the public should be over-nice with reference to any art, such books as that before us, will tend more than anything else to raise such art to its proper grade. Chap. ii contains some really good remarks that bear upon this point, and we will close by quoting a few passages:

"There is no pleasure so great among those which pertain to the rewards of success as that which comes from the toil of the hands well and honestly engaged; there is none more satisfactory to the mind, than that which unites the knowledge of what to do with the act of well doing; and when these qualities are associated, and are supported by perseverance, they are the sure basis of present respectability and future independence.

"Labor, properly directed by education, must secure reputation to the individual and benefit to the community. It is not in the learned professions that either fame or fortune is always found; neither is it political success that yields either greatness or content.

"If trade is followed merely for the sake of its moderate gains, it will always keep its votaries in a dull road of antiquated forms and habitual error; but if men are taught in their earlier days, that education is the best preparative for the work-shop, they will bring with them into their future laboratories the powers of other influences than those of mere ingenuity; they will come with new levers, those of the cultivated intellect; and with the inspirations of a laudable ambition and a forecast of the future, will strike out inventions and improvements to elevate their names and benefit mankind.

"The theory which accounts for the union of oils and alkalies in the formation of soaps, or the decomposition of fats into their crystaline acids, is as abstruse as that which expounds some of the most refined instances of affinities. The manufacture of soaps and candles is, therefore, strictly scientific, and they who desire to advance in that art, must not merely make, but make understandingly; so that each result may be an advancing lesson for their own profit, while it enables them to repay the benefits they have derived from chemistry, by furnishing, from their experience, new lights to their fellow men."

MECHANICS, PHYSICS, AND CHEMISTRY.

Report on an Apparatus for Supplying the Boilers of Marine Steam Engines with a Continuous Supply of Fresh Water. Invented by CAPTAIN JOHN ERICSSON.

Through the courtesy of the Author, C. H. Haswell, Esq., we are enabled to submit to our readers the following interesting report upon some improvements in Marine Engines, invented by Capt. Ericsson, and adapted by him to the United States Revenue Steamer "Legaré."

Capt. Ericsson has since applied his apparatus in the United States Steamer Massachusetts, having made some modifications, which were suggested by the experience in the "Legaré," and we learn that its performance is now perfectly satisfactory. COM. PUB.

New York, October 31st, 1847.

SIR.—In acceptance of your invitation of the 17th ultimo, we, the undersigned, had the honor to meet together in the city of New York, with the view of testing and reporting upon an apparatus invented by Captain John Ericsson, for the purpose of supplying the boilers of marine steam engines with a continuous supply of fresh water, and applied by him under your direction in the United States Revenue Steamer Legaré.

We have now respectfully to report, that on the 23rd ultimo we embarked in the Legaré at 12 M., proceeded to sea, and remained on board till the following morning. During this time the boiler was in operation 15 hours, and we had ample opportunity of examining the means employed for supplying it with water and the results produced.

By the ordinary method of condensing steam in marine navigation, boilers are supplied with the *water of condensation*, composed of the steam that is withdrawn from the boiler and the necessary quantity of salt water required for its condensation. Hence, a boiler in operation is constantly parting with steam (fresh water) and receiving salt water in exchange. The effect of this operation, uninfluenced by a correction, would be, that in a few hours a degree of saturation of the water in the boiler would be reached, that would precipitate upon the plates of the furnaces and flues, a scale of sufficient thickness to arrest the passage of the heat to the surrounding water and cause the destruction of the plates, by exposing them to a temperature destructive of their tenacity. The correction in use is the removal of the water as it approaches saturation, and is effected by *blowing*, or *pumping off*.

In the operation of either of these methods, it is apparent that there is a loss of the heat that has been imparted to the water blown or pumped off, that neglect to open or shut the blow-off cock, or in the admission of the required supply of water, involves the duration of the boiler and may, as it frequently does, involve the lives of the passengers and the crew, and the safety of the vessel. Even when all practicable attention is given to blowing-off, salt scale will be deposited in long voyages, particularly in the middle latitudes, and accumulate to an extent that renders its removal imperatively necessary. This is at all times a difficult, and even under the most favorable circumstances, an imperfect operation, and when this deposit coats the surfaces of the flues, the consumption of fuel is increased to an extent unsuited to the economy of mercantile enterprise and to the duration of operation requisite for naval purposes.

This evil may be avoided by furnishing the boilers with a full supply of fresh water, and as the weight could not be accommodated, nor the space spared in a vessel for an instrument and its fuel for the sole purpose of distilling the quantity required, it is obvious that the steam furnished by a boiler must be returned to it, after being condensed by the radiation of its heat to cold surfaces, and not by the admixture of water. This method was *proposed* by James Watt, so early as the year 1776, and has been effected to some extent by an instrument invented by Mr. Samuel Hall, of England, and applied to the engines of many steam vessels, in some of which, notwithstanding its imperfections, it is yet used. It has failed, however, to answer the full purposes desired and anticipated.

In the arrangement of Mr. Hall a great number of thin metal tubes, from one-half to three-fourths of an inch in diameter, were placed *vertically* in a condenser and exposed to a current of cold water from the sea and into which the steam from the cylinder was admitted, for the abstraction of its heat by the radiation of it to the water without the tubes. Now it is evident, that, by this arrangement, the condensed steam would run down the inner surface of the tubes, in its passage presenting a non-conducting lining to them, and in its collection at their bottom an obstacle to the current of the steam and a diminution of the effective radiating surface.

With this method of condensation, it will be perceived that this instrument provides alone for returning to the boiler, the water that has passed through the engine as steam. It follows, then, that all escapes of steam from the boiler or engine, or water-leaks from the boiler, pipes, &c., must be replaced by distillation, at an expense of fuel, directly as the evaporation. Further continued use of this instrument exhibited an oleaginous deposit upon the inner surface of the tubes from the use of oil and tallow in the steam cylinder and on the valve faces, which, acting as a non-conductor, materially obstructed the condensation of the steam.

The apparatus of Captain Ericsson was designed to obviate the difficulties and deficiencies developed in that of Mr. Hall, and is composed of two distinct instruments, a Condenser and an Evaporator; the first for the purpose of condensation, and the latter for a supply of fresh water to provide for any losses of steam or water from the boiler by escapes, leaks, gauge vents, &c., &c.

The Condenser is a cylindrical vessel set at a slight inclination from a horizontal line, containing the requisite extent of radiating surface in metal tubes of *two inches* bore, with an open space at each end. By this arrangement there is free space for the current of steam to pass and for the condensed steam to run down the lower side of the tubes, without presenting a lining of water to intercept radiation or an obstruction to the course of the steam. Connected with this is a pump, by which water from the sea is drawn in and forced through the spaces between the tubes and the inner surface of the shell of the condenser. Thus, the latent heat of the steam is absorbed by contact with the tubes, and condensation is effected for the double purpose of affording a vacuum for the engine and of restoring fresh water to the boiler, for continuous evaporation and condensation, to meet the requirements of the engine.

The Evaporator, as constructed, is a parallelopipedon with a semicylindrical top and bottom, the lower portion of which is occupied by a number of tubes similar to those in the condenser, which communicate with a valve at each end of the steam cylinder, worked by the engine: around these tubes, and for some distance above them, water from the sea is admitted for the purpose of being evaporated, and the space above this water is open to the condenser and consequently *in vacuo*. This instrument being designed to furnish fresh water to replace that which may be lost, its operation is resorted to only as occasion may require, and is effected in the following manner: when the piston is near the termination of its stroke the valve referred to opens, (above or below as the case may be,) and closes when the piston begins its return stroke; by this arrangement, steam is withdrawn from the engine that has very nearly performed its full expansive effect, and passing into the tubes of the evaporator its heat is absorbed by the water surrounding them, and as this water is *in vacuo* it readily boils at a low temperature, and its vapor being led to the tubes in the condenser, it is condensed with the steam from the cylinder and is supplied to the boiler.

Upon the experimental trial to which you were pleased to request our attention, all practicable arrangements for correct observations were entered into; and with a view to acquire full and progressive notes of the operations of the apparatus, the observations of the various points were confided to special committees, which upon the conclusion of the trial, reported full notes for furnishing the following, viz:

The boiler was filled with fresh water from above the opening of the blow-off cock; below this, salt water had been left, from an impression of its effect being too inconsiderable to authorise its removal.

At the commencement of the operation of the engine, the water in the boiler as indicated by a saline hydrometer, when at a temperature of 150° Fahrenheit, was $\cdot\frac{63}{32}$.*

The highest temperature of the *feed water* observed was 158° Fahrenheit.

The lowest 132°, and the average 150°.

The highest *vacuum* observed was from 16 to 18 inches.

The lowest from 11 to 15, and the average was from 12 to 15 inches.

The highest *steam pressure* was 54 lbs. mercurial gauge.

The lowest was 20 lbs., and the average was 48·6 lbs.

The highest number of *revolutions* was 47 per minute.

The lowest number was 30, and the average 42·3.

The point of cutting off was at three-eighths of the stroke.

The temperature of the sea water was 57.

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* 12-32 being the point of saturation of water when at a temperature of 200°.

Duration of *operation* of the engine and boiler 14 hours and 20 ninutes.—Time during which steam was raised, 20 hours.

DIMENSIONS OF ENGINE, &c.

Cylinder.—36 inches in diameter, with a stroke of piston of 32 nches.

Boiler.—	1400 square feet of heating surface.
Condenser.—	637 square feet of radiating surface.
Evaporator.—	100 square feet of heating surface.

Upon coming to, the freshness of the water was again tested, and vhen at a temperature of 150° by a different thermometer than that ised at the first operation, (it having been broken in the interim,) the iydrometer indicated $\cdot\frac{75}{32}$; whether this difference in the indications is o be attributed to a change in the density of the water or to a difference in the thermometers, they being of different manufactures, we ire unable to decide; fortunately the difference is quite inconsiderale, and is not regarded as deserving of further consideration.

So soon as the temperature of the Condenser was reduced to a degree that rendered an examination of it practicable, one of its heads vas removed in our presence, and the tubes, when examined, were ntirely free from any deposit or incrustation upon their surfaces, and he opinion is entertained, that at a temperature of feed water commensurate with economy of fuel, any difficulty from the deposit of leaginous matter in this instrument is not to be apprehended.

Regarding the particular performances of the Condenser and Evaorator, it appeared that Capt. Ericsson had relied too confidently on general current of the cold water through the former instrument, vhereas the current was quite partial, being but directly through its iarrowest part, the sides of it: hence, the upper portion of it was alnost inoperative—this feature was clearly developed by the application of a hand along the surface—while the effect of it was apparent n the moderate condensation indicated by an attached mercurial auge.

Of the Evaporator, its capacity was clearly shown, in the facility vith which the level of the water in the boiler could be raised through he space between two gauge cocks, and by a resort to its operation iot being necessary for more than one-tenth of the time.

Immediately after the close of this trial, measures were taken to ffect a diffused operation of the cold water, and as diaphragms could iot be introduced between the tubes to alter the current of the water, vithout incurring an impracticable delay, the expedient of causing he steam to circulate through the tubes was resorted to, and was efected by the application of diaphragms in the open space at each end f the tubes. Upon the completion of this, a further trial was had n Friday, the 1st inst., when several observations furnished the folowing:—

Pressure of steam,	50 pounds mercurial gauge.
Revolutions,	47 per minute.
Vacuum,	20·5 inches.
Temperature of feed water,	150° Fahrenheit.
Temperature of sea water,	62° "

Compared with the ordinary method of condensation, the value of the method observed is determined by an investigation and consideration of the following points, viz.: Evaporation, Pressures, Consumption of Fuel, Safety and Duration of the Boiler.

1.—Evaporation. *Ordinary Method.*

Temperature of Feed Water, 100° *Fahrenheit.*

Temperature of sensible and latent heats of steam,	1192°
Deduct temperature of feed water,	100°
Heat to be added,	1092°

New Method.

Temperature of Feed Water, 150° *Fahrenheit,*

Temperature of sensible and latent heats,	1192°
Deduct temperature of feed water,	150°
Heat to be added,	1042°

Then $\frac{1042}{1092} = \frac{\cdot954}{1\cdot00}$ which represents a gain in the evaporating temperature in the new method of 4·56 per cent.

2.—Pressures. *Ordinary Method.*

Pressure of steam—mercurial gauge,	50 lbs.
Vacuum, 28 inches,	=13·7 lbs.
	63·7 lbs.

Cut off at three-eighths of the stroke.

Effective pressure on the piston, =47 lbs.

New Method.

Pressure of steam,	50 lbs.
Vacuum, 20·5 inches,	=10 lbs.
	60 lbs.

Effective pressure on the piston, 44·5 lbs.

Then $\frac{47}{44\cdot5} = \frac{1\cdot05}{1\cdot00}$ which represents a loss in pressure by the new method of 5 per cent.

3.—Consumption of Fuel. *Ordinary Method.*

In the Gulf of Mexico and between the Tropics, it is necessary to blow off, when a hydrometer constructed similar to the one already referred to indicates $\frac{2}{32}$; in the Northern and Southern Atlantic and Pacific oceans, when it indicates $\frac{2\cdot5}{32.}$ Hence $\frac{2\cdot+2\cdot5}{2} = 2\cdot25$ the average point for blowing off.

As the average degree of saturation of feed water is $\frac{\cdot75}{32}$; the quantity of water blown off compared to that fed to a boiler is as ·75 to 2·25, which is in the proportion of 1 to 3.

Temperature of the water blown off at the pressure and degree of saturation given,	290°
Deduct temperature of feed water,	100°
Temperature lost by blowing off,	190°

As the heat to be added for the purpose of evaporation is 1092°—1092 × 3—1, the proportion of feed water evaporated,=	2184°
And 190 × 3—2 the proportion of feed water blown off,	190°
The heat absorbed, is,	2374°

Then $\frac{190}{2374} = \frac{.08}{1.00}$ which represents the loss of heat by blowing off in the ordinary method of 8 per cent.

SUMMARY OF RESULTS.

Gain by Evaporation, - - -	4.56	per ct.
Do. do. Consumption of fuel, - -	8.00	"
	12.56	"
Loss by Pressure, - - -	5.00	"
Total,	7.56	"

Which is a saving in the expenditure of heat, affording a like economy in the consumption of fuel and altogether independent of the loss of heat, by the presence of scale in a boiler, when salt water is used, and from leaks incurred by the oxidizing effects of salt water.

With the *Ordinary Method*, the level of the water in a boiler is constantly varying from one or both of the following causes, viz: the quantity of the water blown off, or the particular extent of opening of the feed valve; while the effective operation of the feed pump and neglect of the blow-off valve, involves the burning, or an explosion of the boiler.

With the *New Method*, these operations are set aside, thus, blowing off is unnecessary, and the supply to the boiler being first obtained from it, the transit being immediate and the communication incapable of restriction, (for if the condensed water was not taken off by the feed pump, the condenser would choke and become inoperative,) there can be no decrease in the level of the water, other than that arising from leaks of water and steam. Further, the use of fresh water in a boiler will extend the term of its duration from three and five years to seven and nine.

With a further modification of the condenser, establishing a more diffused current of the cold water, it is evident that a full vacuum may be obtained, as the practicability of attaining this end by external condensation, has long since been developed, and with a less proportion of radiating surface than is exposed in the instrument referred to. From the analysis however here given regarding pressures and temperatures, it would appear that a full vacuum, with corresponding reduction of the temperature of the feed water is not authorized; and as such departure from the hitherto practice, furnishes the temperature necessary to prevent any oleaginous deposit upon the surface of the tubes of the condenser, practice and utility are in desired harmony.

A very effective and economical element in steam navigation arises with the operation of this new method, from the absence of scale in the boiler, the presence of which is unavoidable where salt water is used, and to avoid the formation of it as far as practicable, other than a low temperature and corresponding pressure are precluded by the waste of fuel and injury to the boiler consequent upon the existence of this scale, acting as a new conductor of the heat to the water—whereas, with the use of fresh water, higher pressures can be worked and economy of fuel attained in an increased expansion of the steam.

Reviewing the facts herein presented, we are of the opinion that the operation of the apparatus of Captain Ericsson, as far as developed, was eminently successful, and that, with the modification of the condenser suggested, a higher degree of vacuum can be readily obtained. In view of the very great importance of the successful introduction of this method of condensation in the merchant and naval services, we recommend to your consideration the propriety of sending the Legaré on a distant cruise, for the purpose of developing the advantages of the apparatus by continued and extended use.

Apprised of the ready attention you have given to this important subject, and the zealous interest you have manifested in its development, we cannot but congratulate ourselves and the profession with which we are connected, that you have seen fit to test this improvement by the construction of the apparatus on which we have been called to report. Such encouragement identifies in the merits of success the patron with the improvement, and is honorable to yourself no less than the nation in whose service you have bestowed it.

We have the honor to be, very respectfully,

Your obedient servants,

CHAS. H. HASWELL,
Engineer-in-Chief, U. S. N.

JAS. J. MAPES, *New York.*

LEWIS TAWS, *Philadelphia.*

JAMES MCFARLAN, *Union Ferry Co. N. Y.*

J. H. TOWRE, *Philadelphia.*

WM. SEWELL, SR., } *Chief Engineers,*
WM. W. W. WOOD, } U. S. N.

To the Hon. ROBT. J. WALKER,
Sec. Treas., U. S.,
Washington, D. C.

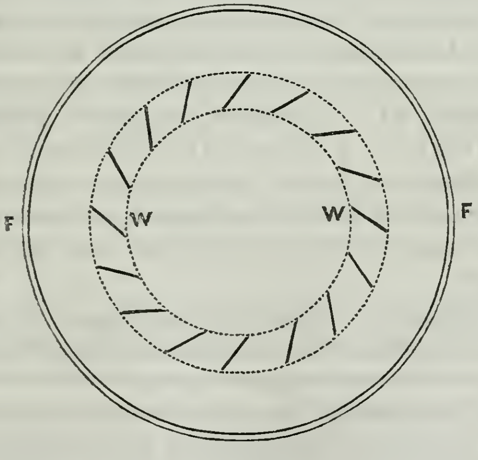
Remarks on the Centre-vent Reaction Water Wheel, by Z. PARKER.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

In my notes of the experiments on the centre-vent-reaction wheel at Troy, I mentioned the fact of the small amount of water discharged, in proportion to the aperture, and of its disposition to uniformity under all velocities of the wheel.

I might have stated that in all cases in which the vanes of the wheel direct the water nearly tangentially to the inner circle of the annular rim of such wheels, the quantity discharged, (under circumstances of full supply,) appears to be about 50 per cent. of the theoretic discharge; and that this proportion appears to be but little affected by changes in the velocity of the wheel, from being held stationary, to any velocity it may acquire by the pressure of the water on the vanes;—or by any change in the circular motion of the water entering the wheel, (at its verge,) either with or contrary to the circular motion of the wheel.

In corroboration of this position, we have the experiments at Troy, in which the discharge (at the maximum) was a trifle less than 50 per cent., owing probably to the unfavorable form of the vanes;—and the 4th set of my model improvements, (the notes of which you have,) where the water passed, inwardly, through a structure, which, when the wheel was removed, was exactly similar to such a wheel,—the quantity discharged in this instance, being just 50 per cent. of the theoretic discharge.



F F Glass Flumes. W W Wheel.

Among the many "interesting objects" at the American Institute Fair, of the present season, there was a centre-discharge-reaction wheel, in a very neatly constructed model, the wheel, about 4 inches in diameter, being made of brass and neatly finished. To the under side of a disk, attached to a vertical shaft, were attached plane vanes extending from the verge to a circle about one-half of an inch from the verge. To these vanes was attached the annular rim, in the usual way. The angle of the vanes directed the water somewhat within the direction tangent to the inner diameter of the annular rim, and after passing into the wheel, it fell through the opening of the rim, and bottom of flume some inches, into a basin beneath. The flume was a glass cylinder about seven inches diameter;—and the supply, a constant stream of "Croton" through a lead pipe,—falling in from the top of the cylinder.

Suspecting from my former experiments that the discharge of such a wheel must be uniform under all velocities, I took the opportunity of experimenting on this, by applying friction to the shaft (about half an inch in diameter) with my fingers. *I could make no sensible variation in the height of surface by any change of velocity, from being held, to running it beyond its natural free velocity, (by rolling the shaft between my thumb and fingers,) nor by turning the wheel backward.*

The accompanying cut represents a section of the vanes.

Philadelphia, November, 1847.

Account of the Experiments to determine the Principal Laws and Numerical Data, which enter into the Calculation of Steam Engines, by M. V. REGNAULT.

The 21st volume of the Memoirs of the Royal Academy of Sciences of the Institute of France recently published is (with the exception of the biographical notice of Professor Blumenbach) entirely devoted to the publication of a series of memoirs by the distinguished experimentalist, M. V. Regnault, the general object of which is thus stated in the title: "Account of the experiments undertaken by order of the Minister of Public Works, upon the recommendation ot the Central Committee upon Steam Engines, to determine the principal laws and numerical data, which enter into the calculation of steam engines."

The facts developed in these investigations, are so interesting in their scientific relations, and so important in their practical bearings, that we propose to present a digested account of them to our readers, and introduce the subject in our present number by a translation of the author's introduction, from which the exact direction of his labors and the simple theory which they are to render applicable to practice, will be clearly seen. COM. PUB.

Introduction.

The theoretic calculation of the work done by steam engines, is founded upon some incontestible principles of general mechanics, and upon several physical laws which are far from having been, up to this time, established upon certain bases. The authors who have written upon the theory of these machines, have been obliged to admit as the basis of their calculations, laws which ought only to be considered as hypotheses to which physical philosophers have been led, most frequently, by extending to vapors, laws which are not even rigorously exact for permanent gases. Thus, when the work really done by a machine is compared with that deduced from the theory, we always find, even in the best machines, a considerable deficit. A great part of this deficit may be attributed to the disturbances produced in the physical conditions, by the very motion of the apparatus; it is due to the loss of active force *(force vive)* occasioned by the cooling of the steam; to the resistance which is developed during its course through tubes of irregular forms, and in its passage through openings, more or less contracted. Finally, there are losses of active force produced by the friction and vibration of the different pieces of which the machine is composed. But a great part of the difference may well be occasioned by the inaccuracy of the fundamental laws which have been admitted into the calculation.

Mechanics have, for a long time, greatly desired a general investigation for the purpose of establishing these fundamental laws upon a series of direct experiments executed with the means of precision which physical sciences now present. I had for some time formed the determination of devoting myself to this work, and had several times tried some introductory experiments, which however, served only to show me that precise results could only be obtained by means of large apparatus, whose expense of construction far surpassed the very narrow means which we have at our disposition in our physical laboratories, and I should have been completely stopped in the execution of my projects, if the Minister of Public Works, upon the suggestion of M. Legrand—under Secretary of State, had not, with a kindness which will be appreciated by all the friends of science, placed at my disposal the funds necessary for the execution of this long and laborious work.

In order to show clearly what are the principal laws upon which the theory of steam engines rests, it appears to me necessary to explain, in a few words, the principles of this theory. All known systems of steam engines may be divided into four classes:

1. Engines without expansion, and without condensation.
2. Engines with expansion, and without condensation.
3. Engines without expansion, but with condensation.
4. Engines with both expansion and condensation.

The first three classes, may, in a theoretic point of view, be considered as particular cases of the fourth class, which presents the most complex case; the only one to which it is necessary for us to pay attention. We shall suppose an imaginary engine, which is not subjected to any external cause of cooling, nor to any loss of active force by friction, contractions of orifices, &c., &c We shall suppose the boiler to be of very great capacity in comparison with the cylinder, so that the pressure of the steam may be considered as absolutely constant in the boiler during the motion of the machine, the heat of the furnace reproducing, constantly, the quantity of steam consumed by the machine.

Let ω be the surface of the piston expressed in square metres.*

x, the space described by the piston from the instant of the arrival of the steam in the cylinder, with the tension which it has in the boiler, until the moment at which we are examining it.

P, the constant pressure of the steam in the boiler, expressed in kilogrammes and referred to a square metre of surface.

T, the temperature of the steam.

v, the capacity, in cubic metres, of the part of the cylinders described by the piston from its starting point to the height, x.

V,' the total capacity of the cylinder.

I. A first law, which it is important for us to know, is *the law which connects the elastic forces with the temperatures.*

We will distinguish two periods during the stroke of the piston: during the first of these the cylinder communicates freely with the boiler; the total pressure of the steam upon the surface of the piston is $P\omega$.

If the piston advances by a quantity dx, the element of work produced will be, $P\omega dx = P dv$.

The whole quantity of work produced during the first period, that is, from the beginning of the motion of the piston until the introduction of the steam is stopped, (corresponding to a capacity V, described by the piston in the cylinder,) is P V.

During the second period, which is that of the expansion, no more steam comes from the boiler, but the steam contained in the cylinder continues to press upon the piston; as this rises, the steam occupies a larger space, its elastic force diminishes, and its temperature is lowered by the absorption of latent heat during its dilatation.

Experiment has not decided what are the laws which govern these variations; but one of the following cases must happen:

First case. The quantity of heat absorbed by a kilogramme of liquid water at 0° (32° Fah.) in passing into vapor, (which, for the sake of simplicity, we shall call, *the total heat of the steam,*) is the same, whatever may be the pressure, provided the vapor be at its maximum of density. If this law be exact, the steam will always remain in a state of saturation during the whole period of the expansion; the pressures of the steam will vary in the inverse ratio of its volumes, and they will constantly present the relations to the temperatures, which connect the temperatures of saturated steam with its elastic forces.

Second case. The total heat of the steam increases in proportion as its elastic force is greater. As we suppose that the steam is not subjected to any external cooling influence, it is evident that, in proportion as the steam dilates into a larger space, it will require a smaller quantity of total heat to keep it in the state of vapor. Consequently, during the dilatation, there will be a disengagement of a certain quantity of latent heat, which will become sensible to the thermometer, and will raise the temperature of the steam above the point which corresponds to its saturation. The temperature of the steam will then be more slowly reduced than in the former case ; the steam will be found overheated during the expansion, and the pressure of the steam upon the piston will diminish more slowly than it would according to the law of Mariotte.

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* In the following translation we have preserved the French units of length, weight, and temperature. The metre is 39·371 inches. The kilogramme 2·205 lbs., av.

The degree of the Centigrade thermometer, 1·8 degrees Fahrenheit.

To reduce Centigrade to Fahrenheit degrees, multiply them by 9, divide the product by 5, and add 32°.

Third case. The total heat of steam is less in proportion, as its elastic force is greater. If this law were true, there would be a precipitation of liquid water during the expansion, the steam would remain constantly saturated, but the elastic force would decrease more rapidly than according to the law of Mariotte.

In the absence of decisive experiments to shew the accuracy of one of these three hypotheses, mechanicians have generally adopted the first, which is at the same time the most simple and the most precise. This hypothesis assimilates the expansion of steam to that of a permanent gas, dilating in a variable space, whose walls constantly restore to the gas the quantity of heat which is absorbed in the latent state during its expansion, so that its temperature remains invariable.

The work developed during the expansion is then calculated in the following manner: Let v be the volume of the steam, and p its pressure at a given moment; dx the space described by the piston, while the volume becomes $v+dv$; the element of work produced will be $p\omega dx=pdv$. At the commencement of the expansion, the volume is V, and the pressure P, and as we admit the law of Mariotte between the volume of the steam and its elastic force during expansion, we shall have

$$p=\frac{PV}{v}, \quad =pdv=PV\frac{dv}{v}$$

and the whole work produced, while the volume of the vapor passes from V to V′, is $\int_{V}^{V'} PV\frac{dv}{v}=PV\log.\frac{V'}{V}=PV\log.\frac{P}{P'}$

This is the expression for the work produced during the period of the expansion. The total quantity produced during a complete stroke of the piston, is then,

$$PV\left(1+\log.\frac{P}{P'}\right)$$

We have heretofore attended only to the pressure which is exerted upon one of the faces of the piston, but the other face is constantly submitted to the pressure which exists in the condenser. We will suppose this latter pressure to be constant during the stroke of the piston, and represent it by f. The amount of resistance which it will have produced during the stroke of the piston, will be

$$fV_1=f\frac{VP}{P_1}$$

So that the moving power will be expressed by

$$PV\left(1+\log\frac{P}{P_1}-\frac{f}{P_1}\right)$$

If n represents the number of strokes of the piston per minute, the power developed during this unit of time, will be expressed by

$$nPV\left(1+\log.\frac{P}{P_1}-\frac{f}{P_1}\right)$$

But the accuracy of the formula depends upon the accuracy of the hypothesis which we have admitted, and it is necessary to determine by direct experiments.

II. *The quantities of heat which must be given to a kilogramme of water, at 0°, to vaporize it, under different pressures.*

These quantities of heat are composed of two distinct parts—the heat necessary to raise the temperature of the liquid water from 0° to the point at which the change of state takes place, and the latent heat of vaporization. If we wish to distinguish these two parts of the total heat of steam, we must determine by experiment—

III. *The capacity for heat of water at different temperatures.*

Finally, if the total heat of steam is not constant under all pressures, in order to calculate the effect of expansion, we must still learn—

IV. *The specific heat of the vapor of water in different states of density, and at different temperatures.*

The theoretic power of a steam engine may be estimated, by stating the amount of power which it is capable of giving for each kilogramme of steam consumed.

To do this, let ϖ be the weight of a cubic metre of steam under the pressure P, and at the temperature T, π the weight of steam consumed by the machine in one minute. We shall have $nV=\frac{\pi}{\omega}$, and consequently the power given by the machine, from a kilogramme of steam, will be expressed by $P\frac{\pi}{\varpi}\left(1+\log.\frac{P}{P_1}-\frac{f}{P_1}\right)$

But in order to calculate, under all circumstances, the value of ω, we must know—

V. *The law according to which the density of saturated vapor of water varies under different pressures;*

VI. *The co-efficient of dilatation of the vapor of water, in its different states of density.*

Mechanical philosophers generally admit that the weight (ϖ) of a cubic metre of steam, under the pressure P, and at the temperature T, may be calculated by applying to saturated steam the law of Mariotte, and the law of the uniform dilatation of gases. Now, these laws are not even rigorously exact for the permanent gases, and it is to be feared that they are completely false for saturated vapors. Finally, the method most generally adopted to compare steam engines, consists in stating the work which they perform for each kilogramme of fuel consumed. To do this, we must know the weight (K) of steam under the pressure P, which a kilogramme of the fuel can develope under the circumstances in which it is employed; and we then have, for the work performed by a kilogramme of fuel,

$$P_1K\frac{\pi}{\varpi}\left(1+\log.\frac{P}{P_1}-\frac{f}{P_1}\right)$$

The quantity K, depends upon a variety of circumstances which we cannot now discuss, such as the quality of the fuel, the nature of the furnace, the arrangements of the boiler, &c., &c., &c.

To sum up then, the theoretic calculation of steam engines requires the knowledge of the following laws and data:

I. The law which connects the temperatures and elastic forces of saturated steam.

II. The quantities of heat which one kilogramme of liquid water at 0° absorbs, in being converted into saturated steam, under different pressures.

III. The quantities of heat which one kilogramme of liquid water at 0° requires to elevate its temperature to that at which it assumes the state of steam, under different pressures.

IV. The specific heat of aqueous vapor, in different states of density, and at different temperatures.

V. The law according to which the density of saturated steam varies, under different pressures.

VI. The co-efficients of dilatation of steam, at different densities.

Before commencing the search for these different laws, it was necessary to treat several preliminary questions, so as to fix with certainty, the indispensable auxiliary data, and, above all, to define clearly the conditions which must be fulfilled by the thermometers, by means of which we measure the temperatures, in order that these instruments may be rigorously comparable.

These preliminary researches obliged me to undertake, successively, long series of experiments, the necessity of which I was far from foreseeing when I undertook the work. I was in fact obliged to undertake the re-determination of a great number of data, which, for the most part, appeared to be fixed with complete certainty, by the researches of my predecessors, and as to which physical philosophers entertained no doubts whatever.

The whole of these researches will be published in a series of detached memoirs. I intend, at the end of my labors, to sum them up in a report, which will be addressed to the Minister of Public Works, in which the results will be presented under a form suitable to the especial view with which the work was undertaken—that is, the theoretic calculation of steam engines.

My experiments frequently required the assistance of a great number of observers. I was frequently obliged to avail myself of the kindness of several of my students, among whom it gratifies me to cite especially Messrs. Bertin, Grassi, Bertrand, Lissajoux, and Silberman. Let me be permitted to return to them, thus publicly, my thanks.

But I must, in a very especial manner, testify my gratitude to my friend M. Izarn, for the zeal and complete devotion with which he has aided me in this long series of labors, some of which were not without danger, and all were very troublesome, as well as in the long and tedious numerical calculations which were the consequence of them. By the aid of his active co-operation, I have been able to terminate these labors in much less time than it would have been possible for me to have done it, if I had been reduced to my own personal efforts alone.

(To be Continued.)

On the decomposing power of Water at high temperatures, by Richard A. Tilghman, Read before the American Philosophical Society, Philadelphia, August 20, 1847.

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It has long been noticed, that partial decomposition is often effected in attempting to render anhydrous, by heat, certain salts which require a comparatively high temperature for the expulsion of their watery crystalization. This effect is not limited to those salts which are capable of decomposition by the action of heat alone, but extends to many which, when previously rendered anhydrous, are entirely unaffected by this agent. The chloride of magnesium offers a striking instance of such an action, being almost entirely reduced to magnesia, with escape of hydrochloric acid, when its solution is evaporated by a strong heat; the anhydrous chloride, when obtained by other processes, is, on the contrary, unaffected by the highest heat.

Even chloride of calcium, a salt of much stronger radical base, has been observed to give off a portion of acid, when all its water of crystalization is driven off by a red heat. In these and many other instances, it seems evident that the escaping water of the salt is the actual decomposing agent, and that the intensity of its action depends solely upon the degree of heat which the salt can sustain before giving it off.

Contact of the salt and water, at high temperatures, appears to be the only requisite of decomposition. It was therefore thought probable, that by exposing the salt, even in its anhydrous state, to a high heat, and passing over it a current of aqueous vapor, raised to a similar temperature, not only might the above mentioned salts be completely decomposed, but also that many others which have hitherto given no such signs of partial decomposition, might be acted upon in a similar manner.

On making the experiment, it was found, that not only the anhydrous chloride of calcium, but also the chlorides of strontium and barium could be rapidly decomposed by exposing them, at a high red heat, to a current of steam; hydrochloric acid was copiously evolved, and escaped along with the excess of steam, while the bases of the respective salts were left in a free state; the lime remaining anhydrous from the intensity of the heat employed, while the baryta and strontia combined with a portion of aqueous vapor, and were found in the state of hydrates.

In these haloid salts, it is to be observed, that the addition of the elements of water is absolutely essential to the decomposition; as neither the hydrogen which is contained in the acid, nor the oxygen in the base, existed in the anhydrous salt. The action is, therefore, the result of a double decomposition between the steam and the chloride, as well as of the affinity of the liberated acid and base for water.

The oxysalts, and the sulphates of magnesia, lime, strontia, and baryta, unlike the haloid salts just mentioned, contain, even in the anhydrous state, all the elements generally considered necessary for the separate existence of the acid and bases of which they are composed. The application of the strongest heats to these salts, causes, however, no liberation of their acid; but, as with the chlorides, this effect is immediately produced by the passage of a current of steam over them at a high temperature, the baryta and strontia being left in the state of hydrates, and the other bases anhydrous.

The intensity of the affinity between the acid and base of the respective salts, is curiously illustrated by the gradual increase of the heat necessary for their decomposition by the aqueous vapor.

Thus the sulphate of magnesia gives off its acid to the current of steam at a low red heat, and consequently a large portion of the acid may be condensed in an undecomposed state. The sulphate of lime requires a high red heat for its decomposition, and on this account the greater part of its acid is resolved into sulphurous acid and oxygen gas. The decomposition of the sulphates of strontia and baryta, requires progressively higher heats, which, in the case of the last salt, must be raised even to low whiteness.

The subphosphate of lime, as it contains an acid much less volatile than sulphuric, combined with an excess of a powerful base, which adds to its stability, was selected as one of the most difficult tests of this decomposing power of aqueous vapor: by a full white heat, however, its phosphoric acid was slowly disengaged. This phosphoric acid gave a white precipitate with nitrate of silver, showing that its liberation and subsequent condensation in contact with a great excess of aqueous vapor, had not prevented that change which heat is known to produce upon this acid.

It might be expected from the decomposition of the salts of baryta, that the sulphates and muriates of potash and soda would undergo the same change with even greater facility. But it was found by experiment, that although the decomposition of these last salts commenced with facility, when they were exposed to steam at a red heat, yet the proportion of alkali thus liberated, never exceeded a very small per centage of the residual salt, however long the operation might be continued. Attributing this peculiarity to the volatile nature of the liberated hydrates of potash and soda at high temperatures, substances capable of forming non-volatile combinations with the alkalies, were mixed with their salts, previously to subjecting them to the action of the steam; the acids were then found to be completely disengaged with facility. The fact that both lime and magnesia, substances capable of forming chemical combinations of but the most feeble character with potash and soda, were found to produce the above effect, was considered as confirming, in a great measure, the hypothesis that the volatility of their hydrates was the cause of the apparent difficulty of completely decomposing the salts of these alkalies.

The subphosphates and subsilicates of lime, baryta, and strontia, act in the same manner as lime and magnesia, and in all these cases the chemical combination is so feeble that, when cold, the alkali is disengaged by the solvent powers of water alone.

Alumina, which possesses so much of the acid character with respect to the strong bases, is proportionably more efficient than any of the preceding substances in aiding the decomposition of the alkaline salts: it remains in combination with the alkali, when cold, as a soluble aluminate; but is easily precipitated from its solution by a current of carbonic acid gas.

The calcination of potash alum, leaves a mixture of alumina and sulphate of potash, which Berthier has long since stated to be converted into aluminate of potash by the continued action of heat alone, the sulphuric acid being expelled from the potash by the superior affinity of the alumina at a high temperature. By several careful repetitions of his experiment, in which the accidental presence of aqueous vapors was entirely prevented, no decomposition of this kind could be effected, even at a white heat. But by the contact of aqueous vapor, produced by the combustion of the fuel or otherwise, even in small quantity, and at much lower temperatures, the decomposition is rapidly produced. It therefore seems probable that the accidental contact of aqueous vapor was the actual but unnoticed cause of the decomposition in Berthier's experiment.

The powerful action of aqueous vapor upon anhydrous alum at a high temperature, suggested the possibility that a similar action might take place upon its mineral representative, the double silicate of alumina and potash, or common felspar. It will be remembered that this salt, by the simple substitution of sulphuric for the silicic acid which it contains, would be converted into anhydrous alum. To the action of heat alone, felspar presents this difference from alum, that the silicate of alumina is as unaffected by it as the silicate of potash itself; so that to produce an effect upon felspar analogous to that upon alum, the silicic acid of both the silicate of alumina and of the silicate of potash would have to be removed. Silicic acid, in a *free* state, having been long known to be slightly volatile in aqueous vapor at high temperatures, it was thought that, in the present case, it might, like the other acids, be disengaged even from a state of chemical combination, by the same agents. Steam was therefore passed slowly, for some time, over small fragments of highly heated felspar. Beyond partial fusion, no other visible change than a considerable degree of vesicularity in the parts most exposed was produced. These fragments, being finely pulverized and boiled in water, the concentrated solution was strongly alkaline, and proved, by the usual tests, to consist of aluminate of potash.

After water ceases to extract aluminate of potash from the powdered mineral, dilute sulphuric acid will produce from the residue a small portion of alum. The actual analogy between alum and felspar, substances so distinct in their origin and general properties, yet differing only in the nature of their respective acids, is rendered still more striking by both thus yielding the same product, when deprived of their acids by the same agent. It is worthy of remark, that, although the actual contact of the steam in this experiment is confined to the mere surface of the small fragments of felspar, yet the chemical decomposition produced by it is not confined to that surface, but spreads by a "cementation action," through their entire mass: pulverization is, therefore, required to obtain evidence of the internal change which has been produced.

All the experiments, so far made, would indicate that the following was the general rule applicable to all salts capable of sustaining heat alone without decomposition :

Whenever a salt, from its own elements alone, or by the addition of those of water, can produce a volatile acid and a fixed base, the evolution of this acid and the liberation of this base will be determined by passing a current of aqueous vapor over the salt raised to a high temperature. When either the acid or base to be liberated forms a combination with water which can resist decomposition by the heat employed, the tendency to form such hydrates adds much to the decomposing power of the aqueous vapor. Although potash and soda are not by themselves fixed bases at high temperatures, yet by the use of the substances before mentioned, they can form combinations which are fixed, and by this means their salts come under the above rule.

The actual number of salts which have as yet been subjected to this mode of decomposition, is not very large; yet, from their perfect analogy of composition with many others, there can be but little doubt of the general extension of the principle.

The chlorides of potassium, sodium, barium, strontium, and calcium, being all thus decomposed, the bromides, iodides, and fluorides of the same and all weaker bases, must probably act in the same manner. The fluoride of calcium, has, in fact, been found to do so, by experiment, hydrofluoric acid being freely evolved. In the same manner, from the decomposition of the sulphates, may be inferred that of the seleniates; from the silicates, that of the borates.

The applicability of this simple mode of decomposition to the explanation of a great variety of geological changes, is too evident to escape the attention of those conversant with that science. In a future paper I hope to be able to give a more complete account of some interesting facts which have been observed in connexion with this subject, and to verify, by experiment, many points which must at present be left to inference and conjecture. In fact, although the existence of this law of decomposition was ascertained in 1842, yet it has only been within a few months that I have been able to give much attention to its investigation, which must be my excuse for the imperfect and hurried manner in which it is now communicated.

London, August 3, 1847.

Note on the means of testing the comparative value of Astringent Substances for the purposes of Tanning, by ROBERT WARRINGTON, Esq.

Having been frequently called upon to examine the value of astringent substances imported into this country for the purposes of tanning, such as valonia, divi-divi, sumac, cutch, &c., I am induced to believe that the detail of the manipulation adopted may not be without interest to some of the members of the Society. As the manufacture of leather was the object of the purchaser of these materials, gelatin was selected as the basis for the estimation of their comparative value; and after several trials with various kinds of natural and manufactured gelatin, such as varieties of isinglass, glue, patent gelatin, &c., the finest long staple isinglass was found to be the most constant in its quality, and least liable to undergo change.

With this, therefore, the test solution was prepared, of such a strength, that each division, by measure of the ordinary alkalimeter tube, should be equivalent to the one-tenth or one-fourth of a grain of pure tannin, and thus the number of divisions used would indicate the proportion of available tannin or substance precipitable by gelatin contained in any specimen. A given weight of the sample under trial was then infused in water, or if necessary, the astringent matter extracted by boiling, and the clear liquid precipitated by the test solution, until no further deposit occurred.

It was necessary in the course of this operation, to test at intervals a portion of the solution under examination, to ascertain the progress of the trial; and this, from the nature of the precipitate, was attended at first with some little difficulty: paper filters were inadmissible, from the quantity of the solution they would absorb, and thus introduce a source of extensive error; subsidence rendered the operation very tedious. The plan I have adopted is as follows:—a piece of glass tubing, about twelve inches in length and about half an inch internal diameter, is selected, and this has a small piece of wet sponge loosely introduced into its lower extremity, and when it is wished to abstract a part of the fluid under investigation for a separate testing, this is immersed a few seconds in the partially precipitated solution; the clear liquid then filters by ascent through the sponge into the tube, and is to be decanted from its other extremity into a test glass; if, on adding a drop of the gelatin solution to this, a fresh precipitate is caused, the whole is returned to the original bulk, and the process proceeded in, and so on until the operation is perfected; this method of operating is facilitated by conducting the examination in a deep glass. After a few trials the manipulation will be found extremely easy, and in this way considerable accuracy may be arrived at.

Chem. Soc. Mem.

FRANKLIN INSTITUTE.

Monthly Meeting, January 20, 1848.

After reading the minutes, and the correspondence received, donations were announced from the Zoological Society, London; Thomas Clemson, Esq., Brussels; Eben N. Horsford, Cambridge, Mass.; Pennsylvania Railroad Company, Union Canal Company, S. W. Roberts, Esq., T. H. Forsyth, Esq., and John Lenthall, Esq. Foreign and domestic exchanges for the Journal, were also announced. Reports from the Treasurer and various committees were received—new members proposed—and those proposed at last meeting elected.

On the report of the Committee on Exhibitions, the following resolution was adopted:

Resolved, That a First Premium be awarded to Jordon L. Mott, of New York, for Cooking Range No. 1784, shown at the last exhibition—a premium not having been awarded by the Committee at that time, under the impression that it had received a premium at the previous exhibition, which was not the case.

Communications on subjects connected with science and the arts, being next in order—

Mr. C. W. Chapman exhibited to the meeting a machine for sharpening tools, which he calls "the Universal Instrument Sharpener," and explained the mode of its operation. By a compact and ingenious arrangement of machinery, the foot of the operator communicates, at the same time, if required, a rotary motion to a vertical and to a horizontal grinding stone, and also a vibratory motion to a hone for finishing the edge. The stones may be easily changed, and coarser or finer ones substituted; or polishing wheels, if desirable. Adjustive rests and bevel plates are so adapted and regulated by scales, as to enable the grinder to give any desirable bevel to the edge, and to maintain it throughout. Feeders for water and oil are so arranged as to supply the stones, and keep them clean. The machine may also be applied to grinding porcelain, and cutting glass, or other hard substances. The axle of the vertical stone is terminated by a socket, into which drills may be inserted. So compact is the machinery for producing all the different motions, that it occupies little more than a cubic foot of space.

Mr. M'Comb, of Mississippi, exhibited a machine for pressing cotton, hay, tobacco, or hemp, intended to be worked by horse power. The horse is attached to a horizontal bar, fixed in a perpendicular shaft, around which winds a strong rope, fastened to toggle joints in two upright bars, on opposite sides of the revolving shaft. As these joints are drawn, by the rope, towards the shaft, the upward extension of the jointed bars forces up the moveable bottom of the box containing the material to be operated upon, and thus communicates the required pressure. The machine appears to be well calculated for working expeditiously and effectively. The inventor states that forty bales of cotton may be pressed in a day, with the same number of hands required for ten or twelve bales, by the ordinary method.

He also showed a model of a device for raising vessels when aground, called a Steamboat Spar, operating on the toggrel joint principle, and explained the mode of its application.

Mr. G. W. Smith called the attention of the meeting to specimens of manufactured Gutta Percha, by Mr. Willmarth, of New York. One of these was a sheet of the pure material, thin as paper, and somewhat similar, in appearance, to the finest oiled silk. Being impervious to water, it may be applied to many useful purposes, such as lining hats, shoes, and other articles of wear, covering the stoppers of bottles, and a variety of other uses. Mr. S. referred to its electric properties, which he had found to be very remarkable. He also exhibited a pair of shoes lined with this article, the soles of which were also thickly coated with gutta percha. They had been worn for several weeks with satisfaction, and were not found so liable to slip in wet weather, as shoes prepared from caoutchouc. The use of gutta percha, for a great variety of purposes, promises to become extensively beneficial.

The notice of the members was next directed to specimens of *Chloroform*, a chemical preparation recently brought into use as a substitute for sulphuric ether, in producing insensibility to pain during dental and surgical operations. Some discussion ensued, between Prof. Frazer and Mr. Smith, relative to the history of this article, and its identity with the preparation by Dr. Guthrie, called Chloric Ether, noticed in Silliman's Journal, January, 1832.

A sample of chloroform from Paris—another by E. Roussel, of Philadelphia—and a third by Farr, Powers & Weightman, of Philadelphia, were each administered to three different gentlemen present, who voluntarily submitted to the experiment, in order that the effect of this article might be witnessed by the members present.

On the report of the Judges, the President declared the following gentlemen duly elected Officers, Managers, and Auditors, for the ensuing year:

President, ...	Samuel V. Merrick.
Vice Presidents, ...	Thomas Fletcher, Abraham Miller.
Recording Secretary, ...	Isaac B. Garrigues.
Corresponding Secretary,	Solomon W. Roberts.
Treasurer, ...	John F. Frazer.

Managers:

John Struthers,
M. W. Baldwin,
Frederick Fraley,
John Agnew,
John Wiegand,
Samuel Hufty,
John C. Cresson,
A. W. Thompson,
Thomas U. Walter,
John H. Towne,
Edwin Greble,
David S. Brown,
Thomas S. Stewart,
Owen Evans,
Cornelius A. Walborn,
Alan Wood,
John E. Addicks,
Williams Ogle,
Asa Whitney,
Isaac S. Williams,
Edmund Draper,
William E. Morris,
William P. Cresson,
James P. Ellis.

Auditors, S. Byerly,
Joseph Cresson,
Algernon S. Roberts.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA,

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MARCH, 1848.

CIVIL ENGINEERING.

Report of the Board of Managers to the Stockholders of the Mine-Hill and Schuylkill Haven Railroad Company, at their Annual Meeting, January 10th, 1848.

The Board of Managers of the Mine-Hill and Schuylkill Haven Railroad Company, respectfully present to the Stockholders their annual report.

The year 1847 has been one of great activity, both as respects the current business upon the road, and the extension of facilities for the accommodation of the rapidly expanding trade.

The net tonnage, as shown by the Collector's returns, amounts to five hundred and eighty-three thousand five hundred and ninety tons 13-20; being nearly one hundred and eighteen thousand tons, or 25 per cent. greater than that of the year immediately preceding.

The total tonnage that has passed the Company's scales, is three millions seven hundred and six thousand eight hundred and fifty-seven tons; of which two hundred and forty-one thousand and fifty-two tons, have passed over the road free of toll, under an allowance made to the operators in the shape of a deduction from the gross weight.

The improvements of a permanent character, completed during the year, have been—the extension of the road from Schæffer's creek, on the West Branch, to the town of Tremont, in the valley of the Swatara, a distance of seven and a quarter miles; and the reconstruction of a considerable portion of the road, to fit it for the introduction of locomotive engines, under the provisions of the supplement to the charter, passed on the 9th of March last. Both of these improvements have been attended with greater labor and expense than was anticipated previously to their commencement. The preparation of the road for the engines, involved the necessity of relaying with a heavy edge rail, weighing sixty pounds to the yard, one track upon the entire length of the main road, and several miles upon the branches.

In many places new grading was required for obtaining the requisite width between the tracks, and at other points it was necessary to make an entire change of location, to avoid curves that were deemed impracticable for locomotive engines. The bridges were thought to be of insufficient strength, and as they were likewise too narrow to admit of increasing the width between the tracks, the greater number of them were removed—although many had been newly erected only a year ago—and were replaced by new structures of sufficient strength and width. In some instances, the piers and abutments were rebuilt in a more substantial manner, and the retaining walls of many of the embankments have also been renewed.

In addition to these important improvements on the road, a large amount of entirely new work has been executed, in providing water stations and wood depots, at several points, and in the construction of a large building of a substantial and permanent character, for the accommodation of the engines, which has been erected on a convenient site, recently bought for that purpose. The difficulty and expense of executing these works were much increased by the necessity for carrying them on concurrently with the large trade upon the road, amounting to several thousand tons per day; passing at all hours, and requiring the track to be kept constantly passable, both for cars and horses. To avoid the hazard of serious accidents, it was deemed best to interrupt the transportation temporarily, for the reconstruction of several of the larger bridges, on the lower part of the road: accordingly, when the preparations were sufficiently advanced, due notice was given to the operators, and a suspension of trade for four days, occurred in the month of July. The introduction of the engines was precipitated, before the arrangements were completed, by the restlessness of the teamsters engaged in hauling upon the road, who demanded from the operators new contracts, extending to the end of the year, with a large increase of compensation, giving notice to their employers that the teams would be withdrawn on the 14th of August, unless these demands should be complied with.

On the urgent solicitation of the operators, and with a desire to relieve them from this embarrassment, the Board consented to commence running the engines upon the lower part of the road, at the period thus designated by the teamsters; such of the engines as were ready were accordingly placed upon the road, and have continued in use, gradually extending their trips as the needful preparation of the road progressed, until they have reached the extremities of three of the branches, and to within a mile of the head of the other two. On one of these they are stopped at a point about a mile below the head, by a curve of such short radius, as to be impracticable for engines, the removal of which requires the consent of the neighboring land owners, and the co-operation of the Forest Improvement Company, at whose instance, and for whose sole benefit, this portion of the road was located.

On the other branch, the switches of the operators have not yet been prepared for the safe use of the engines.

As soon as these impediments shall have been removed, their trips will be extended to the extremities of all the branches.

Upon the important practical questions relative to the class of engines best adapted to the character of the road, and the number requisite for carrying the trade, an engineer of extensive experience was consulted; and in accordance with his advice, the Board contracted for six engines, weighing from fifteen to seventeen tons; three from the manufactory of M. W. Baldwin, and three from that of Norris Brothers. Owing to delay in the delivery of some of the engines beyond contract time, the motive power in possession of the Company was not sufficient for the trade at the time appointed for the withdrawal of the teams; but the deficiency was supplied by the President of the Philadelphia, Pottsville, and Reading Railroad Company, who obligingly offered the use of some of their engines, until our own were received.

The number of engines contracted for, was supposed to be sufficient for carrying not only all the trade upon the old road and its branches, but also for that of the new road to Tremont, then nearly completed. This expectation would have been realized, if due regularity in the arrival of the empty cars at Schuylkill Haven could have been attained; but owing to the great irregularity of the supply of cars, the whole force was required for the trade on the old road, and it became necessary to secure a seventh engine for the exigency of the Tremont trade. This is of a heavier class than the others, weighing about nineteen tons, with eight driving wheels, all connected: it has been used partly on the new road, and partly on the older branches.

In view of the probable increase of the trade, and gradual deterioration of the engines, it has been deemed proper to make provision of three more, to be placed on the road in the ensuing spring; making in the whole, ten engines, of a class adapted for heavy freight, which it is believed will be an ample force for any amount of trade that may reasonably be anticipated.

In addition to the purchase of iron rails, amounting to one thousand tons, reported last year, the greater part of which were designed for the new road, a further supply became necessary for the adaptation of the road for the new motive power; and a contract was accordingly made with the proprietors of the Phœnixville Works for six hundred tons, a portion of which, amounting to three hundred and thirty-eight tons, has been received and laid upon the road, and the remainder will probably be delivered early in the spring, and will be laid without delay; completing the line of heavy rails upon all the branches, but about two and a half miles, requiring about two hundred and fifty tons more of the same kind of rail. The series of permanent improvements will be completed, so far as is at present contemplated, by the enlargement of the engine house for the reception of the additional engines, and the erection of a machine shop, properly stocked with tools and machinery, for the repair of the engines and other apparatus connected with their use.

The road, with its branches, will then embrace about nineteen miles of double track, and eight miles of single track, laid with heavy edge rails, and provided with all the necessary stations for water and wood; substantial buildings and machinery for housing and repairing engines, and sufficient motive power for a trade of eight hundred thousand tons per annum.

These multifarious and extensive works have not been executed without a corresponding outlay of money; whereby the funds derived from the last increase of the Capital Stock, authorized by law, were exhausted, before the whole was completed. To provide the requisite means beyond the capital subscribed, a loan has been contracted under the authority conferred on the Board, at the special meeting of the Stockholders, convened on the seventh of October last, to the amount of one hundred and twenty thousand dollars; being part of a loan of two hundred thousand dollars, bearing interest at the rate of six per cent. per annum, which is to be secured by a mortgage of the fixed property of the Company, executed to trustees chosen at the same meeting. The loan has been taken by the Stockholders at par; an instalment of forty thousand dollars has been paid in, of which twenty thousand dollars have been appropriated to the payment of a prior loan of the same amount, for the extinguishment of the mortgage by which it was secured; and the remainder has been applied to the liquidation of the expenses incurred in the improvement and extension of the road and its appurtenances, to which purpose the future instalments will also be devoted.

The supplement to the Company's charter, authorizing the last increase of the Capital Stock, embraced a clause, requiring a reduction of the tolls from two to one and a half cents a ton a mile, to take effect after the 27th of March, then next ensuing. By a resolution of the Board, the reduction took place on the *first* of March last, and has resulted in a diminution of the receipts for tolls, which partly neutralizes the effect of the large increase of transportation; and diminishes the last half yearly dividend to seven per cent., being one per cent. below the limit prescribed by the charter.

The anticipated increase of the trade in the current year will, it is believed, be sufficient to restore the dividend to its legal limit, and leave a surplus to be applied to the restoration of the depreciation fund, on which large drafts have been made by the extraordinary repairs of the last two years; and also for the institution of a sinking fund for the redemption of the recent loan.

The completion of the new road to Tremont was delayed, by circumstances beyond the control of the Board, to so late a period of the business season, as to allow but little opportunity of testing the capacity of that region, to fulfil the promise of furnishing a remunerating trade; but so far as a judgment may be pronounced, the indications are of a favorable character.

Among the numerous objects which have claimed the attention of the Board, there are two having especial claim, by reason of their important influence upon the economical use of locomotive power. These are, the introduction of anthracite as fuel for the engines; and the framing of a system of regulations for the government of the speed, and general management of the transit on the road, whereby the liability to accidents, involving serious hazard of human life, and interruption of business, may be reduced to its lowest practicable limit. The latter of these objects, it is hoped, may be attained, by gradually digesting a scheme of regulations, based upon daily experience, and adapted to the peculiarities of the road and its trade.

The experiment of using coal has been attempted in one of the engines, and although the results may not be considered to have been as yet fully developed, they are sufficiently encouraging to warrant a similar trial in the three new engines now about to be contracted for.

The amount of the receipts and disbursements for the year, is exhibited in the abstract of the Treasurer's Report hereto appended.

On behalf of the Board of Managers,

JOHN C. CRESSON, *President.*

Philadelphia, 10*th Jan.*, 1848.

Cutting through the Isthmus of Suez.

The Journal des Debats, discussing the question as to which would be better, a railway or a canal across the Isthmus, says:—"It is proposed by some to overcome the obstacle which now stops the trade and navigation of Europeans, Asiatics, and even Africans, at the Isthmus of Suez, by a railway: by others by a canal. The problem to be solved is: which of the two systems is that which should be adopted? Nature has so disposed it, that all political or commercial communication between the people which form the three continents composing the whole world should take place by sea, consequently that combination which would best serve the maritime interest is that which should be preferred." First, taking the railway project, the Debats goes on to state that between Alexandria, Cairo, and Suez, is a distance of eighty leagues; the execution of a railway along this distance would be easy. With but one line of rails it would cost about 30 or 40 millions of francs, and its working would not cost much, under the dry and preserving climate of Egypt, though it would have to be preserved along parts of its course from the danger of periodical inundations.

"As regards transit, it would carry men and merchandise in about twenty hours from Alexandria to Suez—that is about one-third of the time taken under present circumstances. Compared in the matter of speed to a canal commencing from Peluzium, and having but two locks, one at each end, it would be beaten by steamers, and would gain little, even on sailing vessels. This advantage reduces itself to very little, if it is borne in mind that, for navigation, a great saving in distance would be gained by a canal.

"On the other hand, the inconveniences of a railway are numerous. It does not in the least modify the condition of double transhipment. The existence of such a condition means literally this—complete uncertainty for trade, indeterminate delays, and every chance of a later arrival than if the grand road *via* the Cape had been chosen. Supposing that the isthmus was open by railway, and not by canal, and that a London merchant wished to send merchandise to Bombay or Colombo *via* the Red Sea, he must take the precaution either of sending in advance a vessel from the Cape, or get a vessel freighted in India or at Ceylon, to come to Suez, take in the cargo, and bring it to its destination. This would be simply a piece of extravagance on his part, taking it in a financial point of view, and subject, besides, to risk which nobody would wish to incur. The proof of the impossibility of such an attempt is, that in spite of the perfections to which the service has arrived, nothing arrives in the port of Suez, but the Bombay and Calcutta steamers. A railway would thus be of little use for transit. It would indeed carry men and despatches more conveniently than they are carried at present, but then it would probably not have an increase of either. This is not what is counted upon to create a revenue for a railway, the length of which would extend to 80 leagues.

"Taken as a speculation, the railway does not show itself in a more advantageous light. Experience tells us, passengers and intermediate stations are the great source of profit. It is sufficient to cast a glance over the map of Egypt, to see that from Alexandria to Cairo, two-thirds at least of the distance is uninhabited; and even were a population to exist, such a one would be plunged in abject misery, without trade or industry, without activity, as well as without desire to acquire, because it would know where the fruits of its labor would be taken. Such a population would not be one to appreciate the boon of locomotion. Locomotion is regarded by all people of the East, Chinese, Turks, Hindoos, Arabs, &c., as a malady of our kind. No doubt, an agreeable picture might be formed in imagination, representing the fellahs of Egypt traveling in a railway train; but few, however, have traveled and seen their sad villages, and probed their physical and moral wounds; such a picture would be but a cruel jest. In fine, in a political point of view, one consideration alone should prevent Mehemet Ali from ever giving his consent to the execution of such a project, and for this he need only remember that some years ago the English founded a transit company on his territory, which has since become an object of such constant annoyance to him, that he was obliged to take the matter in his own hand. Yet this administration did not count more than twenty Europeans employed in it. What will not happen, if the Viceroy brings into his country the engineers, stokers, smiths, and all who are necessary for working a railway? Taking all circumstances into consideration, the railway would in reality be but a consecration for the trade of the world of the *status quo:* for Egypt it would introduce into its bosom a dangerous weapon, the explosion of which might take place anywhere but in Cairo and Alexandria."

London Naut. Mag.

Comparative Fares of Railroads in the United States.

As the comparative rates of fare on railroads is a subject of some interest, we avail ourselves of the labors of Mr. Minor, the industrious editor of the American Railroad Journal, as exhibited in the following tabular statement of the principal railroads in the United States, giving their length, through fare, and rate, per mile, from which it will be seen that the New York and Erie Railroad charges the lowest rate, namely, 1·72 cents per mile; the Harlem next, and then the Long Island Railroad. The New England roads all range below three cents, except the New Haven, Hartford, and Springfield, which is one-tenth over. And the next lowest, after the New England roads, is the Weldon and Wilmington, N. C., which is a fraction less than 2½ cents—quite too low for a country so thinly populated, though high enough for many of the more northern lines.

From this statement, it will be seen that the railroads in the State of New York, diverging from the city of New York, charge lower rates than any other roads in the country; and we presume the managers of these roads have been influenced by the belief that, where there is a dense, and, to a certain extent, confined population, the true plan is to put the rates of fare low, and thus induce the masses to use the road. This, we are fully convinced, is the true policy, and we believe it will ultimately prevail.

Name, Commencement, and Termination.	Length. Miles.	Thro' fare $ cts.	Cents. per mile.
Eastern Railroad—Boston to Portland,	105	3 00	2·85
Boston and Maine—Boston to Portland,	110	3 00	2·72
" Lowell—Boston to Lowell,	26	0 65	2·50
" Worcester—Boston to Worcester,	44	1 25	2·80
" Providence—Boston to Providence,	42	1 25	2·97
Fitchburgh—Boston to Baldwinsville,	71	1 75	2·46
Fall River—Boston to Fall River,	53	1 35	2·54
Old Colony—Boston to Plymouth,	37½	1 00	2·66
Western—Worcester to Albany,	156	3 75	2·27
Nashua and Lowell—Lowell and Nashua,	15	0 40	2·66
Concord—Nashua to Concord,	34	0 80	2·35
Norwich and Worcester,	60	1 50	2·50
New Haven and Springfield,	62	1 87	3·00
Bridgeport,	98	2 00	2·04
New York and Harlem,	53	1 00	1·88
New York and Erie,	87	1 50	1·72
Long Island,	95	2 00	2·10
Camden and Amboy—New York to Philadelphia,	90	3 00	3·33
New York and New Brunswick,	33	0 75	2·27
" Philadelphia,	88	4 00	4·54
Reading—Philadelphia and Pottsville,	92	3 00	3·26
Philadelphia and Baltimore,	97	3 00	3·01
Westchester and Columbia,	32	0 75	2·34
Philadelphia, Lancaster, and Harrisburg,	107	4 00	3·73

Name, Commencement, and Termination.	Length. Miles.	Thro' fare. $ cts.	Cents. per mile.
Philadelphia, Germantown, and Norristown,	17	0 40	2·38
Harrisburg, and Chambersburg,	56	2 12	3·78
Baltimore and Ohio—Baltimore to Cumberland,	179	7 00	3·91
" Washington,	40	1 60	4·00
" Susquehanna,	71	2 13	3·00
Washington and Richmond, (including porterage),	133	5 50	4·13
Louisa—Gordonsville,	50	3 25	6·50
Richmond to Petersburg,	22½	1 00	4·34
Winchester and Potomac,	32	2 00	6·25
Petersburgh and Roanoke—Weldon,	63	3 00	4·76
Weldon to Wilmington,	161½	4 00	2·48
Wilmington to Charleston by steamboat,	——	4 00	——
Gaston and Raleigh,	87	4 00	4·60
South Carolina—Charleston to Augusta,	136	6 75	4·96
Columbia—Branchville to Columbia,	68	3 38	4·97
Georgia—Augusta to Atlanta,	171	7 00	4·09
Athens Branch,	39	1 95	5·00
Western and Atlantic—Dalton,	100	5 00	5·00
Central—Savannah to Macon,	191	7 00	3·65
Macon and Western—Atlanta,	101	4 00	3·96
Montgomery and West Point,	60	3 00	5·00
Vicksburgh and Jackson,	47	3 00	6·38
Albany and Schenectady,	17	0 50	2·94
Greenbush and Troy,	6	0 20	3·33
Troy and Schenectady,	20½	0 50	2·43
Utica and Schenectady,	78	3 00	3·84
Utica and Syracuse,	53	2 00	3·77
Syracuse and Auburn,	26	1 00	3·84
Auburn and Rochester,	77	3 00	3·89
Rochester and Attica,	44	1 56	3·54
Attica and Buffalo,	31½	0 94	2·98
Buffalo and Niagara Falls,	22	0 75	3·40
Lockport and Niagara Falls,	24	0 75	3·12
Michigan Central—Detroit to Kalamazoo,	146	4 40	3·00
Detroit and Pontiac,	25	1 00	4·00
Erie and Kalamazoo—Toledo to Adrian,	33	1 00	3·00
Southern Michigan—Monroe to Hillsdale,	70	2 00	2·85
Mad River—Sandusky to Bellefontaine,	102	3 25	3·18
Little Miami—Cincinnati to Springfield,	84	2 00	2·38
Lexington and Ohio,	28	1 25	4·46
Mansfield and Sandusky,	56	1 50	2·67
Madison and Indianapolis,	86	3 00	3·48

It will be found that the railroad companies in the above list adopting the lowest rates of fares, pay the largest dividends. An unanswerable argument in favor of low fares. Hunt's Merch. Mag.

AMERICAN PATENTS.

List of American Patents which issued in the month of November, 1846,—*with Exemplifications, by* Charles M. Keller, *Engineer and Attorney for Patents, and late Chief Examiner of Patents in the U. S. Patent Office.*

1. For *Improvements in the Drill for Planting Wheat;* Henry W. Smith, Paradise, Pennsylvania, November 4.

The patentee says,—"The nature of my invention consists in so constructing the drill as to raise the teeth when not in use for the purpose of conveying it from place to place, and in forming the seed distributing cylinder in two parts, so that the wheels can be attached directly to the cylinder, while at the same time they have a motion independent of each other—the quantity of the seed to be distributed being regulated by means of a sliding concave attached to the front of the said hopper."

Claim.—"Having thus fully described my improvements, what I claim as my invention, and desire to secure by letters patent, is, first, the employment of a cylinder for seeding, divided into two parts, and directly attached to the wheels, in the manner and for the purpose set forth.

"I also claim elevating the teeth, in the manner and for the purpose specified; and, lastly, I claim gauging the quantity of grain by means of the adjustable concave and wedges, as described."

2. For *Improvements in Artificial Legs and Feet;* Benjamin F. Palmer, Meredith, New Hampshire, November 4.

We have to omit the claim in this instance, on account of its dependence on the drawings.

3. For an *Improvement in the Machine for Scraping and Sweeping Chimneys;* James Slaughter, Strasburg, Pennsylvania, November 4.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the scrapers, brushes, and cars, as constructed and arranged for the purpose set forth."

The scrapers and brushes are attached to spring bars on a polygonal hub, and connected with the whole is a part called the "car or traveling part," which moves from the hub in drawing up the apparatus to draw the spring bars with the scrapers and brushes inwards, to permit the whole to be elevated freely."

4. For an *Improvement in the Shower Bath;* Horace Wells, Hartford, Connecticut, November 4.

Claim.—"I am aware that boxes for shower baths have been made similar to the one described before, therefore, I do not claim the box; but what I do claim as my invention, and desire to secure by letters patent, is the pump or pumps worked by treadles in combination with the shower bath or baths, as herein described, or in any manner substantially the same, so that the pump can be worked while the hands are left at liberty."

5. For *Improvements in Wooden Bridges;* Lowman Gay, Chili, New York, November 4.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of bracing together the upper and lower arch-pieces of the arch trusses, connected together with rods or posts, by connecting the ends of the braces with the arch-pieces at a sufficient distance from the rods or posts, and from each succeeding brace, to cause the parts of the arch-pieces between the ends of the brace to act as levers, to transfer the strain from one brace to another throughout the series, substantially as described.

"And I also claim the method of sustaining the bridge against a lateral thrust, by means of the two inclined trusses connected together at top, substantially as herein described."

6. For an *Improvement in Printing and Coloring Maps and Prints;* A. D. McKinzie, Philadelphia, Pennsylvania, November 6.

Claim.—"Having thus fully described my invention and its uses. what I claim therein as new, and desire to secure by letters patent, is the combination of a series of sliding tympans, with a corresponding series of plates for printing colors, so that a sheet, when put into the machine, shall receive successively an impression from each plate; the whole forming a vari-colored impression."

7. For a *Combined Pen and Pencil Case;* Jacob D. Hatcher, Philadelphia, Pennsylvania, November 6.

Claim.—"Having thus fully described my combined pen and pencil case, what I claim therein as new, and desire to secure by letters patent, is the combining the pen-holder in the same case with the pencil-holder, by means of the sliding tubes, combined and operating with the main tube, substantially in the manner herein set forth."

8. For an *Improved "Reserve for Leads in Pencil Cases;"* Albert G. Bagley, New York, November 6.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of forming a "reserve" for leads in the outer or revolving cylinder of the machine, by cutting grooves in the periphery of the latter, and covering them with an outer casing of silver or other suitable material, as herein set forth."

9. For a *Machine for Making Sheet Metal Guards for Cap Spinners;* William Cundell, Patterson, New Jersey, November 10.

This invention consists in griping and bending the end of a strip of tin (to form that part of each which makes the connexion with the one next it) on a permanent die, by means of a jointed bender, the faces of which correspond; then bending it over the curved edge of the bender into a semi-cylindrical cavity in the upper part of this bender by a cylindrical die jointed to the stand on the opposite side of the permanent die to which the bender is jointed, and then completing the cylindrical bend over the other portion of the cylindrical die by a hollow segmental former, jointed to the bender above the semi-cylindrical cavity thereof.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of, *first*, the permanent die, the bender, and the cylindrical die, as described; and, *second*, the permanent die, the bender, the cylindrical die, and the segmental former, as herein described."

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10. For an *Improvement in Dry Docks;* Hugh K. Wagner, St. Louis, Mobile, November 10.

This is for a mode of balancing the dock, by means of boxes outside the dock, on the ends of levers, as expressed in the following

Claim.—"I claim the moveable lever, in combination with the dry dock, as the most important and substantial part of my invention and improvement, and disclaim all other parts of the dock hereinbefore mentioned."

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11. For an *Improvement on Tide Water Wheels;* Thomas Rowand, Philadelphia, Pennsylvania, November 10.

Claim.—"I do not claim to have invented the adoption of a gate for turning the water upon the wheels; but what I do claim as my invention, and desire to secure by letters patent, is the construction and adaptation of the two gates in the mode specified, alternating with, and successively acted upon by, the tides, in combination with a wheel, as described, so that either the ebb or flow will find one of the gates, which serves as a guide-water towards the wheel, without changing the direction of motion of the latter."

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12. For an *Improvement in Water Wheels;* Hiram Munger, Chicopee Falls, Massachusetts, November 10.

Claim.—"I am aware that the water has been discharged from a wheel at the bottom near the outside and inside at the same time; but in that case it was discharged downward or fell from the lower edge of the buckets, and through openings in the permanent bottom over which the wheel moves, they (the buckets) being projected beyond the shrouding of the wheel into the shute which lets the water into the wheel.

"But what I claim as my invention, and desire to secure by letters patent, is the employment of a wheel having the shrouding extending out to the periphery of the buckets, which are open inside and outside when combined with a three or more sided flume surrounding it, which flume is provided with a shute on each face to discharge the water into the wheel outside at given distances apart, leaving sufficient room between the shutes for the discharge of the water in tangential lines from the outside of the buckets, substantially as herein described; whereby the water is discharged mainly from the outside of the buckets, when the wheel moves with a velocity equal, or nearly equal, to that of the water by which it is impelled, and mainly inside when it is loaded, and moves much slower than the water by which it is impelled, as described."

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13. For *Improvements in the Turbine Water Wheel;* Theodore R. Timby, Cato Four Corners, Cayuga county, New York, November 10.

Claim.—"I claim making the two rims or flanches that envelope each other so as to constitute the two passages and issues for the water with their inner surface of the gradually decreasing eccentricity, herein described, whereby the water may continue to act on these eccentric surfaces, as its motion from the centre of the wheel is gradually diminished, at the same time gradually decreasing the width of the passages between the flanches inversely, as their length is increased by the increased diameter, as described.

"And I also claim making the outer extremity separate from the rims or flanches, so that they can be removed, and others of different lengths substituted, as described, that the wheel may be adapted to the varying capacity of the column of water."

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14. For an *Improvement in Rotary Shears for Cutting Metal;* L. & L. J. Lamb, Berlin, Connecticut, November 10.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the inclination of the two arbors of the rotating shears to the plane of the plate to be sheared, so as to leave a free passage for that part of the sheet that is being cut off, in combination with the bevelled face of one of the shears, as herein described. We also claim the mode of setting the cutting edges of the shears to each other by having the arbor of one of them to slide in its bearings, and forced up by a set screw, in combination with the spring that draws it from the other cutter, to prevent the injurious action of the cutting edges on each other, and to admit of their relative adjustment of the two cutters, as described."

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15. For *Improvements in the Drawing Frame for the Manufacture of Yarn;* Joseph Pray and C. Stafford of East Killingly, Connecticut, November 12.

The "nature of this invention consists in making each section of the first or back set of rollers conical, that the supply of cotton, &c., to the other rollers may be more or less, to increase or decrease the draught on the fibres, and thus regulate the size of the yarn; and also in combining with this, guides connected with the condensing tube, which is on the upper edge of a vibrating arm, the connexion between the guides and arm of the condensing tube, being made by means of levers, so arranged that when the yarn is too large, and binds, the tube shall be drawn towards the calender rollers, and thus operate the guides to carry the roping towards the smaller diameter of the conical rollers to diminish the supply."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is making each section of the first or back set of drawer-rollers of a drawing frame conical, for the purpose of regulating the size of yarn or roping, substantially as herein described.

"We also claim the vibrating condensing tube, in combination with the conical draw-rollers, for the purpose of operating the guide to guide the roving in its passage to the conical rollers, substantially as herein described."

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16. For a *Method of performing Surgical Operations without Pain;* C. T. Jackson and W. T. G. Morton, Boston, Massachusetts, November 12.

Claim.—"What we claim as our invention, is the hereinbefore described means by which we are enabled to effect the above highly important improvement in surgical operations, viz: By combining these with the application of ether, or the vapor thereof, substantially as above specified."

The merits of this invention have been so extensively discussed in the public journals, that we deem it unnecessary to say anything further on the subject.

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17. For an *Improvement in the Coffee Roaster;* James W. Carter, Boston, Massachusetts, November 12.

Claim.—"I am aware that a cylindrical roaster and furnace have been combined together and long known and used for roasting coffee, etc., and therefore I make no claim to such contrivances; but that which I do claim is the combination with the furnace and roasting-vessel, of the air space or chamber surrounding it—the same being for the purpose of preventing the too rapid escape of heat from the furnace when its (the air-chamber) induction and eduction air openings or passages are closed, as well as for other purposes, whenever desirable to so convert it, as above set forth."

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18. For an *Improvement in the Washing Machine or Rotary Fulling Mill;* Ira Avery, Tunkhannock, Pennsylvania, November 12.

A conical fluted roller is placed on a crank arm of a central shaft so as to pass around near the inner periphery of a circular tub.

Claim.—"Having thus fully described the construction and operation of my improved washing machine, or rotary fulling-mill, what I claim therein as new, and desire to secure by letters patent, is the combination of the conical fluted-roller with the tub, substantially in the manner and for the purpose herein set forth."

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19. For an *Improvement in the Machine for Handling Hides in the Process of Tanning;* A. H. Beschormann, New York, November 14.

Claim.—"The figure 4 shows a mode of fitting the rollers with plain small gear on the ends near the power, and having a small leading or intermediate pinion between each pair of wheels. The figure 5 shows the rollers carrying stud-wheels fitted with a band chain; and figure 6 shows the rollers fitted with cranks, the pins of which are jointed to one driving-bar. In either of these modifications of the means for enabling the power to turn the rollers all in one direction, the connexion with the power may be in any usual mode—therefore need not be detailed here; and as all the several parts used are well known, no claim can lie for them irrespective of the manner in which they are constructed, and the purposes for which they are employed; therefore my claim for that which is new and of my own invention, and what I desire to secure by letters patent, is limited to the application of rollers, in combination with an apron or endless web, and constructed to operate within competent vats or enclosures, when such application, combination, and construction are employed for the separate or several and successive purposes of washing, lining, vatting, tanning, stuffing, or dubbing hides, substantially as described and shown."

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20. For an *Improvement in the Cider Mill for Grinding and Pressing Apples;* G. W. D. Culp, Allensville, Indiana, November 14.

Claim.—"Having thus fully described my improvements, what I claim as my invention, and desire to secure by letters patent, is, constructing a cider press as herein described, having a tub with a grated curb within it, and a screw through its centre, as set forth, so as to dispense with a frame, and allow it to be combined with a mill for grinding the apples so that the pomice need not be handled."

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21. For an *Improvement in the Rotary Steam Engine and Pump;* Elisha Hale, Newark, New Jersey, November 14.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is putting the valves into and out of action by the united effect of the attached drivers, the elliptical raised circle, and the grooved block, substantially as described."

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22. For an *Improvement in the Tuyere;* Melvin McKay, Lyons, New York, November 14.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is combining the nozzle boxes with the curved air tube, in such a manner that their position can be so adjusted as to bring their discharge apertures nearer to, or remove them farther from, each other; thus adapting them to fires of different magnitudes, and of a greater or less degree of intensity, substantially as herein set forth."

23. For an *Improvement in the Forge Tuyere;* Daniel C. McMillen, Persia, New York, November 14.

Claim.—" By this arrangement the blast from the tuyere is susceptible of many variations, without changing the direction of the wind, and is the most easily adapted to any kind of business. What I claim as my invention, and desire to secure by letters patent, is the construction of an adjustable bellows tuyere by the combination of a cylinder or shell, with a piston or roller placed therein to regulate and vary the blast, in the manner aforesaid."

24. For an *Improvement in Circular Shears for Cutting Sheet Metal;* Samuel Hall, New York, November 18.

We are under the necessity of omitting the claim, because of its dependence on the drawings—it is however limited to the combination of parts by means of which the centre, on which the plate rotates as it is being cut, slides to and from the shears to describe an ellipse.

25. For an *Improvement in the Machine for Cutting Flocks in the Manufacture of Woollen Cloth;* Asa Barber, Stephentown, New York, November 18.

Claim.—" I do not claim as new the cutting of the flocks in a dry state ; but what I do claim as my invention, and desire to secure by letters patent, is the combination of the spiral revolving cutters and the bed of straight cutters with the revolving screw and the floats, operating substantially in the manner and for the purpose set forth."

26. For an *Improvement in the Machine for Cutting Fodder;* Luke S. Rand, Townsend, Vermont, November 18.

Claim.—" I am aware that I cannot claim a simple knife elevated and depressed as described ; but that which I do claim is the improvements applied to the lever and frame of the cutting knife in order to regulate the balance or weight of lever applied to the knife, as well as the angle of the cutting edge of the knife with respect to the plate against which it acts, as above explained ; also, the vibratory weighted board, in combination with the cutting knife and feeding trough, the same being for the purpose as above specified."

27. For *Improvements in the Machine for Cutting Grass;* Isaac Lard, Ashley, Missouri, November 20.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is—

"1st. The arrangement of the revolving rake for taking the grass from the scythes as fast as cut, and depositing it in the rear, in combination with the revolving scythes, arranged and operating in the manner and for the purpose above set forth.

"2d. I claim the arrangement of the curved bar for bearing off the heads of the grass to enable the cutters to cut the grass more effectually, in combination with the frame, as set forth."

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28. For an *Improvement in the Harness Saddle;* John T. Denniston, Lynde, New York, November 20.

Claim.—"Having thus fully described the manner in which I construct my improved harness saddle, and presented also some of the advantages of that mode of constructing, what I claim therein as new, and desire to secure by letters patent, is the forming of such saddles by means of two castings, which embrace the skirt or skirts and jockeys between them, and are so formed and combined as to brace and strengthen the lower casting, their union being formed by the aid of screws, without the necessity of nailing or stitching of the leather, and the respective parts being formed and combined substantially in the manner set forth."

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29. For *Improvements in the Machine for Reaping and Harvesting Grain;* Andrew J. Cook, Delphi, Indiana, November 20.

The patentee says,—"The nature of my invention consists in the construction and movement of a rake for taking the grain or straw off the platform of the cutters at regular intervals, and in the manner of steering the machine."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the revolving rake, constructed and combined with the cutting apparatus in the manner described.

"I also claim the arrangement of steering the machine as herein fully described, in combination with the grain-cutting apparatus, as herein fully set forth."

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30. For an *Improvement in Door Fasteners;* L. R. Livingston, J. J. Roggen, and C. Adams, Pittsburg, Pennsylvania, November 24.

Claim.—"We do not claim a lever eccentric revolving on a pin for fastening the latch, but what we claim as our invention, and desire to secure by letters patent, is combining the lever eccentric with the upper screw of the keeper and the latch, as herein described."

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31. For an *Improvement in the Flues of Cooking Stoves;* D. S. Payson, Nicholas Burch, and R. M. Davis, Eaton, New York, November 24.

Claim.—"Having thus fully described our invention, what we claim as new, and desire to secure by letters patent, is the construction and arrangement of the flues as herein described, in combination with two ovens, so that a large portion of both ovens shall be surrounded by the flue, in the manner and for the purpose set forth."

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32. For *Improvements in Machinery for Cutting Wood Screws;* Thomas J. Sloan, New York, November 24.

The object of this invention is to cut the threads on pointed wood screws, so as to form the thread on the conical point with all the turns at equal distances apart, and of a gradually reduced depth, the cone of the thread being gradually merged in the cone of the core. This is effected by causing the cutting edges of the chasers that cut the upper and the under surface of the thread gradually to approach the pitch line of the thread, as they approach the apex of the conical point.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is retarding and accelerating the motion of the alternate cutters in making pointed screws, substantially in the manner and for the purpose set forth.

"I also claim the employment of a series of cutters acting alternately on the blank to cut and finish the thread of the screw, as set forth, all placed upon the same side of the axis of the screw blank."

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33. For an *Improvement in Harpoons;* John Holmes and Abner West, Tisbury, Massachusetts, November 24.

Claim.—"What we claim as our joint invention, and desire to secure by letters patent, is the construction of the fluke or barb of the harpoon in two parts, in such manner that when it is made to enter a whale or other object of attack, one part, being movable, may turn, and thereby diminish the chance of its withdrawing; and the making of the handles or shank of several wires or rods, instead of one solid piece."

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34. For an *Improvement in the Machine for Cutting Sheet Metal;* W. Bulkley and P. Norton, Berlin, Connecticut, November 28.

Claim.—"Having thus fully described the nature of our improvements in the machine for cutting sheet metal into circular plates, what we claim as new therein, and desire to secure by letters patent, is making the main bow of the form described, in combination with the half bow which carries the shafts or spindles of the circular shears, thereby causing the shafts or spindles of the circular shears to be nearly in plane with the axis of revolution, and allowing said circular shears to be moved in or out to any required distance, without interfering with their adjustment to each other; the said half bow, when affixed in place, constituting a part of the main bow or frame, and the space between the cutter shafts, allowing of the free passage between them of the plate that is being cut, thereby admitting of the cutting of any number of articles from the same plate without its being first necessary to divide said plate into separate parts."

35. For an *Improvement in the Truss for the Cure of Hernia;* Adolph F. Ahrens, Philadelphia, Pennsylvania, November 28.

Claim.—"Having thus fully described my improved truss, what I claim as my invention, and desire to secure by letters patent, is the combination of the pad with the body spring of a truss in the manner set forth, so that the pad can be conveniently adjusted into its position, and retain its universal freedom of action, as described, by means of the double nut and screw."

List of American Patents which issued in the month of December, 1846, with Exemplifications, by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in the Machine for cutting Screws;* Peter H. Watson, Rockford, Illinois, December 3.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the right and left screw and sliding frame with the dies, for the purpose of centring, feeding, marking, and smoothing the bolt, while the screw is being cut upon it by the chaser, the whole being arranged and operated in the manner herein set forth."

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2. For an *Improvement in the Machine for making Barrels, Casks, &c.;* Philip Estes, Adrian, Michigan, December 3.

Claim.—"Having thus described the construction and operation of my improved machine for making barrels, casks, &c., what I claim therein as new, and desire to secure by letters patent, is the attaching the howeling, crozing, and chamfering cutters to the disk, in such a manner as to give them an adjustable and an elastic outward bearing against the inner side of the ends of the hooped staves of a barrel or cask, by means of stocks, sliding plates, radial slots, spring, set screws, collar, connecting rods, and lever, combined and operating substantially as herein set forth."

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3. For an *Improvement in the Hill Side Plough;* James Rorabough, Luney's Creek, Hardy county, Virginia, December 3.

The mould board, we are informed, is a section of a cone, which may be shifted from side to side, to plough the side of a hill back and forth. With this mould board a hook is used which keeps it in place, and prevents it from moving too far when shifted.

Claim.—"I claim the shape and use of the hook, in combination with the conical mould board, for the purpose to keep the mould board in its position, and at the same time to serve as a guide in the motion of the mould board, when thrown from one side to the other of the plough, as described before."

4. For *Improvements in the Cooking Stove;* Samuel and G. J. Conrad, Berlin, Pennsylvania, December 3.

We have to omit the claim, because of its reference to, and dependence on, the drawings. The first section is limited to the combined mode of locking the back plate, and the second section to the arrangement of the dampers, in combination with two flues.

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5. For an *Improvement in the Harpoon;* Charles Randall, Palmyra, Georgia, December 3.

Claim.—"What I claim as my invention, and for which I desire to secure letters patent, is the attachment of the movable fluke, behind the stationary flukes, resting against its points on the outer end, and resting against the shoulder in the shank, thus supporting the inner end without depending on the rivet, which is liable to be weakened by rust."

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6. For *Improvements in Weaving Looms;* Melchoir Bretzger, Pittsburg, Pennsylvania, December 5.

We are under the necessity of omitting the claims in this case, on account of their reference to, and dependence on, the drawings.

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7. For an *Explosive Compound, known as the Gun Cotton;* Christian F. Schœnbein, of Basle, Switzerland, assigned to W. H. Robertson, United States Consul at Bremen, December 5th, 1846, to run fourteen years from the 8th of October, 1846, the date of the letters patent granted in England.

Claim.—"What I claim as my discovery, and ask a patent for, is treating vegetable fibrous substances and other organic matter, being of a chemical composition analogous to that of the said vegetable fibrous substances, with a mixture of nitric acid of 1·5 specific gravity, or thereabouts, and sulphuric acid of 1·85 specific gravity, or thereabouts, at the common temperature, or a lower one, by which compounds are formed, which, on being heated more or less, ignite suddenly and produce gaseous matters.

"Of all the vegetable substances known to me, cotton-wool is the most fit material for producing an explosive compound, answering the purpose of gunpowder; and I therefore claim the use of cotton-wool for this purpose, when prepared as herein directed."

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8. For an *Improvement in the Machine for Polishing Cutlery;* Wm. Vine, New York, December 5.

Claim.—"What I claim as my invention and improvement, and desire to secure by letters patent, is the combination of the spiral feeder, arranged and operating substantially as herein set forth, with polishing wheels."

9. For *Improvements in the Machine for Planing, Mortising, and Tenoning Wood and Metals;* Thomas A. Chandler, Rockford, Illinois, December 5.

The patentee says,—"The nature of this invention and improvement consists in combining with the mortising machine, having two ordinary parallel cutters, or leaders, moved alternately by racks and pinion, or segments, two alternate vibrating planes, or cutters, that are caused to cut from the centre of the mortise, towards each end thereof, alternately, in the manner of planes with side cutters—the cutting being performed in parallel right lines, and immediately succeeding the operation of the parallel cutters, or leaders, whilst the levers to which said cutters are attached, have a compound motion from and around their fulcra, caused by the end of the pendulum, which is made with eccentrics, that act against shoulders on the levers of said combined planes and side cutters, and connecting said levers to the pendulum by oblong mortises and adjustable screw pins, inserted into the pendulum."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is combining with the two parallel alternate moving headers, two alternate vibrating cutters connected to and moved by the cogged and eccentric pendulum that moves the headers; whether the said several parts be constructed, arranged, and operated in the manner, and for the purpose above described, or other mode, substantially the same."

10. For *Improvements in Machinery for making Barrels;* Horace Baker, McLean, New York, December 9.

Claim.—"Having thus fully described my improvements, what I claim therein as new, and desire to secure by letters patent, is the combination of the carriage for holding the stave, with the two planes in one stock or frame, at a distance equal to half the length of the stave, and both cutting outward from the centre of motion, as herein set forth, substantially in the manner and for the purpose described."

11. For an *Improvement in the mode of Fastening the Round Tenons of Bedsteads;* Benjamin Hinkley, Utica, New York, December 9.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the sharp metal spurs or segments of threads formed with a sharp and reduced edge on the tenons, in combination with the mortises in the posts, with recesses for the admission of spurs, that the shoulders of the rails may be brought up to the posts before the spurs are worked into the wood, whereby perfect joints can be obtained at each end of a rail, and the sacking pins be placed and retained, all substantially as described."

12. For *Improvements in the Apparatus for Heating, Evaporating, and Refining Liquids, specially intended for the manufacture of Sugar;* Norbert Rillieux, New Orleans, Louisiana, December 10.

Claim.—"Having thus pointed out the principle or character of my improvements, and the manner of constructing and applying the same, what I claim as my invention and desire to secure by letters patent, is: *First*—The method of heating the saccharine juice, in a heater, preparatory to its introduction in the evaporating pans, by means of the waste hot water, or escape steam from the evaporating pans, substantially as described. *Second*—The method of clarifying saccharine juice by heating it in a heater provided with a spout for the discharge of the impurities in the form of scum, and a pipe for drawing off the clear liquid, the said pipe being so arranged as to receive the liquid from the heater below the level of the spout which discharges the scum, and then bending up above the said spout to cause the liquid in the heater to rise sufficiently high to discharge the scum, substantially as described. *Third*—The method of cooling and partially evaporating saccharine juice or other liquids, by discharging the same in the form of spray or drops in a chamber, where it meets with a current of air substantially as described; and this I also claim, in combination with a condenser, substantially as herein described, whereby the liquid intended to be concentrated is prepared for the evaporating pans, and used as a means of condensing the vapor from the pans in which it is to be concentrated, or by means of which the water used for the condensing jet is recooled, substantially as described.

"And, *fifth*—the method, substantially as described, of combining a vacuum striking pan with a series of evaporating pans, the last of which is independent of the striking pans, and the last of the series of evaporating pans can be in connexion with the condenser, and work independently of each other, that either the striking pan or the series of evaporating pans can be worked without the other, as described."

13. For an *Improvement in Bedsteads;* Henry Pace, Senior, Cincinnati, Ohio, December 10.

Claim.—"Having thus described my improvements, what I claim as my invention, and desire to secure by letters patent, is the employment of a centre rail or its equivalent, to which are hinged arms that support the side rails, instead of their being fixed to the posts; the whole being arranged and combined substantially in the manner and for the purpose described."

14. For an *Improvement in Weavers' Harness;* Kasimer Vogel, Lowell, Massachusetts, December 10.

Claim.—"Having thus fully described the manner in which I form my improved heddles, to be used in my new manufacture of weavers' hames, what I claim therein as new, and desire to secure by letters patent, is the making of said heddles by the doubling and twisting of yarn by two sets of spools, each of which will form a cord of three or more strands, and the combining of such strands of yarn, so as to form the ends of the eye, by causing the spindles and spools constituting each set to cross and recross, so as to change places for the purpose of interlocking the yarn, and obviating the necessity of tying a knot or of forming a loop of the ordinary kind. And this I claim, whether the crossing and recrossing of the spindles be effected by hand or by special machinery adapted to that purpose."

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15. For an *Improvement in Cast Iron Wheels for Locomotives and Cars;* Alexander Small, York, Pennsylvania, December 10.

Claim.—" Having thus fully described the nature of my improvement in the wheels for locomotive engines, cars, and other carriages used on railroads, what I claim therein as new, and desire to secure by letters patent, is the placing of the spokes of such wheels at such an angle with the plane of the wheel as that they shall overlap each other, in the manner herein described and represented, whereby a sustaining power is applied to the rim of the wheel, by which its cross fracture is rendered so difficult as to insure its safety under all ordinary usage."

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16. For an *Improvement in Knobs for Doors, &c.;* L. R. Livingston, J. J. Roggen, C. Adams, W. Phillips, and R. Phillips, Pittsburg, Pennsylvania, December 10.

Claim.—" We do not claim to be the inventors of a glass-headed knob, nor of the method of inserting a metallic screw, nut, or pin, into fused glass, the same having been made and done, to our knowledge, before our application. What we do claim, and for which we now ask letters patent, is the mode of combining a metallic neck and collar with a glass head, by means of wire-loops or metallic projections united with the collar, and extending into a glass head, while the glass is in a fused state, as herein described."

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17. For an *Improved mode of casting Door Knobs;* William Higgs, Utica, New York, December 10.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the mode herein described of producing the entire hollow knob in casting, through the use of the dovetailed neck, the sand-core and tube connected, as above described and shown in figure 1, and the placing of these in conjunction for the reception of the metal in casting the knob, the whole being moulded, arranged, and performed substantially in the manner above set forth and described.

" I also claim the combination of the metal tube, with the sand-core, and the dovetailing of the neck, in the manner and for the purpose set forth."

18. For a *Machine for making Cigars;* Hosea Peirce, Winchester, New Hampshire, December 10.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the lower slide with its hinged matrix, in combination with the upper slide, stop, and gate, arranged and operating substantially in the manner and for the purpose herein set forth."

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19. For an *Improvement in the self-acting Brake for Railroad Cars;* William McCammon, Albany, New York, December 12.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the constructing of self-acting and self-retaining anti-collision brakes for railroad cars, by means of the combination of the bumper, spring, brake-shaft, ratchet, and pall, with each other, and with the rubbers, substantially in the manner and for the purpose herein set forth."

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20. For an *Improvement in the Churn;* Samuel B. Howd, Arcadia, New York, December 12.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of a churn having a rotary dasher, which, when in motion, draws the milk and cream in at its end and expels it at its periphery, against stationary breakers fixed at the inner circumference of the tub in which it revolves, in the form and manner, and for the purpose in the foregoing specification set forth."

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21. For *Improvements in the Machine for setting the Tires of Wheels;* George H. Thatcher, Ballston, New York, December 12.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the before described mode or manner of setting a tire around felloes of wheels, by the application of a jointed band, in the manner which I have described, for the purpose of tightening the felloes and spokes, and setting the tire by means of the compression caused by drawing the ends of such flexible bands towards each other by the lever and catch, or by the nut and screw, above described, or other means substantially the same, such as by a wedge or key, and overlapping the ends and securing the tire by bolts, held by nuts or riveted, or by other means substantially the same."

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22. For an *Improvement in the Crank Axle for Carriages;* Oren Tracy, Fitchburg, Massachusetts, December 12.

Claim.—"I therefore claim the additional pipe-box, in combination with the crank of the axle, and either with or without the brace; the whole being arranged, constructed, and operated substantially in the manner and for the purpose as herein above specified."

23. For an *Improvement in Cooking Stoves;* Samuel Winrott, Adams county, Pennsylvania, December 15.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arranging and combining the fire-chamber, placed below the oven, with the flues and damper, in such a manner that the flame and gaseous products of combustion can be carried from the fire-chamber around four sides of the oven, substantially as herein set forth."

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24. For an *Improvement in the Washing Machine;* E. D. Wilson, Philippi, Virginia, December 15.

Claim.—"What I claim as my own invention, and desire to secure by letters patent, is constructing the washing machine with a *swinging concave of rollers,* upon which the clothes to be washed are placed, in combination with a swinging box, open at top and bottom, for holding the clothes in contact with the rollers, and moving them back and forth over the same, having a corresponding follower placed therein, moved simultaneously with said concave of rollers, by means of a triple crank and connecting rods; the concave of rollers moving in one direction, whilst the box, with the follower and clothes therein, moves in an opposite direction, by which the double action is produced, as set forth."

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25. For an *Improvement in the Spinning Machine;* Hiram F. Wheeler, Springville, Pennsylvania, December 15.

The patentee says,—"The nature of my invention consists in securing the usual form of spinning wheel head to a vibrating carriage, running on ways, and combined with a treadle and driving band wheel, in such a manner that a person can spin wool or cotton rolls, without moving from his or her position, and walking to and fro, as is required to be done with the ordinary spinning wheel."

Claim.—"Having thus fully described the construction and operation of my improved spinning machine, what I claim therein as new, and desire to secure by letters patent, is the combination of the ways with the spring, for the purpose of preventing the wheel head carriage from coming back with too much force, and also for preventing its recoil, and retaining it while the roll is spliced, substantially as herein set forth."

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26. For an *Improvement in the Machine for Washing Clothes;* Edward D. Tippet, Georgetown, District of Columbia, December 17.

Claim.—"Having thus described the combination and arrangement of the several parts composing my washing machine, what I claim therein as new, and desire to secure by letters patent, is the manner of combining the washer and tub, as herein described, by means of which various thicknesses of clothes may readily pass through between the extreme inner periphery of the tub and the washer, when driven by the centrifugal force created by the motion of the tub, to its extreme inside."

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27. For an *Improvement in Wheels for Railroad Trucks;* Fowler M. Ray, New York City, December 17.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making railroad wheels in two parts, fitted together substantially as herein described, when embraced and held together by flanches and screw bolts passing through the flanches, in manner and for the purpose substantially as herein described. And I also claim, in combination with this method of constructing and connecting the two parts of railroad wheels, interposing the cushion of leather, or other elastic substance, between the inner and outer portions of the wheel, substantially as described, whereby railroad cars, &c., are relieved of a portion of the jar consequent on the striking of the wheels against the rails, as set forth."

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28. For an *Improvement in the Machine for Crushing and Cracking Corn and Cobs;* W. Beale, Jr., and B. S. Hale, Lowell, Massachusetts, December 17.

Claim.—"Having thus fully described our invention, what we claim therein as new, and desire to secure by letters patent, is the combination of the main cylinder with the small cylinder, (revolving in an opposite direction at a slower speed,) the adjustable concave, and the cleaving concave, respectively armed with teeth, and operating substantially in the manner and for the purpose herein set forth."

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29. For an *Improvement in Cotton Mattrasses;* W. H. Robertson, Consul of the United States for the Port of Bremen, December 17.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, *first,* making mattrasses by confining within a ticking or tickings (made of any material) layers of glazed cotton batting, or unglazed batting, with glazed paper or cloth interposed, substantially as described, to prevent the fibres of the different battings, and those of each batting, from matting together, as described. And, *second,* confining the compressed cotton between two cloths, connected together by means of a cord or cords, when this is combined with a ticking or outer covering, substantially as above described."

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30. For an *Improvement in the Self-adjusting Skirts for Ladies' Dresses;* Sewell Folsom, Bridgeport, Connecticut, December 17.

Claim.—"Having thus fully described my invention, I do not claim the introduction of any substance by weaving; nor do I claim the catching up of cords by sewing them into the cloth of the skirt; but what I do claim, and desire to secure by letters patent, is the method of applying the spring materials to the cloth of the skirt, by giving them the spiral, diamond, or circular, or angular, or other curve and irregular forms, so as to break up the plain horizontal lines, by connecting them with other lines or not, as herein more fully described, for the purpose of forming self-adjusting skirts."

31. For an *Improvement in the Snow Plough, for Clearing Railroads;* Daniel D. Stillwell, Philadelphia, Pennsylvania, December 22.

Claim.—"Having thus fully described the manner in which I construct and combine the respective parts of my snow-plough, what I claim therein, and desire to secure by letters patent, is the combining the share and inclined plane with the double mould-boards, so that the latter may be made to turn on a bolt or pivot, in such manner as to allow the double mould-board to have its position changed on said inclined plane so as to adapt it to the properly dividing of the heap or drift of snow, substantially as herein set forth."

32. For an *Improvement in the Cooking Stove;* Joseph S. Silver, New York City, December 22.

Claim.—"Having thus fully described the manner in which I construct my anthrax cooking-stove, what I claim therein as new, and desire to secure by letters patent, is the special arrangement and combination of the respective parts thereof, as herein set forth : that is to say, I claim the combining of the two ovens or boiler spaces situated on the sides of the fire chamber, with the rear oven, the draught from the fire chamber descending and passing under the partition-plates, on its way to the exit-pipe; and the space under the rear oven being heated by means of the heated air from the air-chamber under the fire-grate, the whole being constructed substantially as herein set forth."

33. For an *Improvement in the Self-acting Brake for Carriage Wheels;* Samuel Cope, Salem, Ohio, December 22.

Claim.—"Having thus fully described the nature of my improvement in the self-acting brake for spring carriages, what I claim therein as new, and desire to secure by letters patent, is the manner in which I have combined the brake with the spring carriage, by means of the arms, of the straps, or rods, connecting the brake-shaft with the hind axle; of the strap connecting the brake-shaft with the fore cross-bar, through the intermedium of the spring and the strap, made fast to the carriage body and to the swingle tree, so as to operate in the manner set forth. I do not claim either of the above-named parts individually, but I limit my claim to their combined arrangement and operation, as herein fully made known. And this I claim, whether the respective parts be formed precisely in the manner described and represented, or in any other that is substantially the same, producing a like result by equivalent means."

34. For an *Improvement in the Cotton Gin;* Edwin Keith, Bridgewater, Massachusetts, December 22.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is placing the mote brush where the rotating stripping brush acts on the teeth of the saws, substantially as described, so that the mote brush shall act on the fibres to separate the motes as the rotating brush strips the fibres from the teeth of the saws, as described."

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35. For an *Improvement in the Machine for Counting;* George W. Edelman, Philadelphia, Pennsylvania, December 22.

Claim.—"What I claim as my invention, is the combination with the liberating latch, and stop, hereinbefore described, of the several mechanical devices herein described for operating the count wheel, so as to adapt the instrument to the purpose of counting in the process of addition without requiring the eyes to be turned from the figures."

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36. For a *Mode of Preventing the Deposit of Saline, Calcareous, or other Earthy Matters, in Boilers;* S. D. Anthony, and Daniel Barnum, New York City, December 22.

Claim.—"We are aware that many vegetable substances have been tried for similar purposes, with varying results, and therefore we do not herein claim any general application of vegetable matters to produce these results; but we do claim as new, and as our own discovery by practical research and experiment, and desire to secure by letters patent of the United States, the application and use of mahogany saw-dust for the purpose of preventing or lessening the formation of any injurious scale on the metal of which boiler flues are formed, substantially as above described."

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37. For an *Improvement in Coffee Pots;* John R. Remington, Lowndes county, Alabama, December 22.

Claim.—"Having thus fully described the nature of my improvement, what I claim as new therein, and desire to secure by letters patent, is the connecting a reservoir, having a double bottom, as described, with the coffee pot, in the manner described, by means of a safety valve, constructed substantially in the manner and for the purpose set forth."

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38. For an *Improvement in Stoves;* Benjamin Shepard, Boston, Massachusetts, December 23.

We omit the claim because it refers to, and is dependent on, the drawings.

39. For *Improvements in the Machine for Carving Wood, Stone, and Other Materials;* Hezekiah Augar, New Haven, Connecticut, December 23.

Claim —"I do not claim the horizontal movements of the carriages, as herein described, in themselves, (they having been before known and used,) but only in combination with the other parts and movements of the machine; nor do I claim the using of a pattern, or the operation of the cutting tool and guide, as such, nor any other part which has been heretofore used: but what I do claim as my invention, and desire to secure by letters patent, is the *circular adjustable chucks*, by means of which the cutting tool can be made to operate not only on a greater variety of surface, but also with much more accuracy and despatch as well as convenience. And I also claim the manner in which I have arranged and combined the several parts and movements of the machine, to wit: combining the two lateral motions of the carriages at right angles with the motion to incline the tablets, and the manner of shifting the chucks, in the course of the operation, so as to bring all parts of the surface (except the bottom) of the block or material to be carved equally within the operation of the cutting tool, while the cutting tool is governed by the guide working on the pattern, thereby enabling the workmen to carve five sides of a cubical figure, and consequently to carve all parts (except the bottom) of irregular figures generally by the machine, operating substantially as herein described."

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40. For an *Improvement in the Slide Valves of Steam Engines;* Stephen F. Gates, Boston, Massachusetts, December 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the following, viz: the above described means of neutralizing the effect of the pressure of the steam (or fluid, as the case may be) upon the back of the valves, and equalizing the pressure of the atmosphere on the upper side of the blank valve, and on the under side of the valve C, thus preventing friction, and allowing the valves to move with perfect ease when under a pressure, as above set forth, viz: by applying or attaching the blank valve to the commonly used slide valve C, as above described, in combination with the false aperture, and the aperture to the atmosphere through the cover, and the inverted seat, as above described, and all operating as above mentioned and set forth."

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41. For an *Improvement in Locomotives;* R. F. Stevens and L. B. Pitcher, Syracuse, New York, December 28.

The patentees say,—"Our invention consists in the application to the wheels of locomotives, of an endless chain combined with gripers, clamps, or catches, in such a manner that they will be fastened to the rail under the foremost wheels, and released under the rear ones, by the revolution of the wheels in whichever direction they may be running."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of gripers, clamps, or catches, with the endless chain, as described, in such a manner as that they will seize the rail, as they come down from over the front wheel, and release it as they rise upon the rear wheel, for the purpose and substantially as described."

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42. For an *Improvement in the Machine for Cutting Sausage Meat;* Edward D. Tippett, Georgetown, District of Columbia, December 28.

Claim.—"Having thus described the combination and arrangement of the several parts composing my meat machine, what I claim therein as new, and desire to secure by letters patent, is the combination of the grooved tub with the revolving knife, as herein described, with the combined relative motion of the tub and knives, as herein set forth, whereby the meat is kept continually in motion, and thereby presented to the knives in various and changing positions."

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43. For an *Improvement in Cooking Stoves;* James R. Stafford, Cleveland, Ohio, December 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination with a cooking stove, of an air chamber between double plates, placed or continued on the sides of the fire-chamber, opposite the oven, in the manner and for the purpose described; the object of this air space being to prevent a radiation of the heat from the outer surface of the stove on the sides, to which are affixed the double plates; and the air, when heated therein, by absorption, is then conducted under and into the oven, for the purpose of heating the same, or it may be used for the purpose of heating apartments, when not needed in the oven, or for the purpose of increasing the draught of the stove."

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44. For an *Improvement in the process of Finishing Raw Hide Whips, by pressing and planing them;* Charles Baeder, Philadelphia, December 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the process herein described of finishing raw hide whips, viz: submitting them to heavy pressure in suitable dies, and subsequently smoothing them by planing with suitable planes, all as herein described."

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45. For *Improvements in the Bellows of that kind of Musical Instruments called Seraphines, &c.;* Jeremiah Carhart, Buffalo, New York, December 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making an exhausting bellows for reed instruments, consisting of two chambers, combined with each other, and with the reeds placed above, so that the chamber next to the sounding board shall be enlarged by a weight on the first flap, substantially as herein described, and exhausted by the action of the second flap, substantially as described. I also claim the method of making the valves, by means of strips of leather, or other materials having like properties, placed over a hole or series of holes, in combination with a cord of India-rubber or other elastic substance, substantially as described, whereby the leather valve is prevented from sagging, when stretched by use, and making noise by striking the valve-seat, as described."

46. For an *Improvement in Gas Burners, called the "Phlogostatic Apparatus;"* Etienne Maccaud, Echallens, Switzerland, December 28.

Claim.—"Having now explained in what my apparatus consists, I now proceed to state in what my claims to novelty consist; and before doing so, I would state that I do not claim any thing new in the construction of burners, or any thing which may have been before in use. But what I do claim is—

"First—The creation around the burner of a hot-air reservoir, (by the means of my metallic or other web,) heated by its proximity to the focus of the combustion, which keeps the flame from all cold air and from all streams of the external air, however feeble they may be, so that the air which feeds the flame comes to it by the single aspiration of the heat, and not by the external force of the atmospheric currents.

"Secondly—I claim the placing of a similar web, as represented with regard to Fig. 1, on the top of the glass, when a current of air is found to proceed from above, and beat down upon the glass; and this second part of my invention I claim only in conjunction with the first part thereof."

47. For an *Improvement in Clocks and Time-keepers*; Chauncey Boardman and Joseph A. Wells, Bristol, Connecticut, December 28.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the placing of the driving spring and fuzee on the same shaft, connecting the same to the movement frame of the clock, and the combination of the same with the barrel F, and movements of the clock, substantially in the manner and for the purpose herein set forth."

List of American Patents which issued in the month of June, 1842, *with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents, in the U. S. Patent Office.*

1. For *Improvements in the Thrashing Machine and Horse Power;* Jesse Bowles, Louisa, Virginia, June 11.

Claim.—"What I claim as my invention, is the dovetail form of he base of the beaters, adapted to be taken out of, and inserted into, the dovetailed grooves in the peripheries of the rings of the cylinders, as described. I likewise claim the construction and arrangement of the curve, so that it can be adjusted to the cylinder at pleasure, by the screws and nuts, and likewise be self-adjustable when any hard substances enter the machine, by means of the obtuse angled perforations and rods passing into said perforations, as described."

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2. For an *Improvement in Steam Valves;* Stephen Parks, Jr., Brooklyn, New York, June 11.

Claim.—" I do not claim the invention of a slide valve, or of an expansion valve, separately; but I do claim as of my invention, the slide valve, with such additional steam ways and faces thereto, in combination with such vibrating expansion valves attached thereto, and connected to each other by a bridle or rod, and closed at will by nuts or slides, the nuts or slides being adjusted and fixed by right and left handed screws, in the manner set forth, or in any other manner that has substantially the same effect."

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3. For an *Improvement in the Machine for Planting Seed;* Wells Kilburn, Lawrenceville, Pennsylvania, June 11.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the double slide for dropping seed in a single furrow, constructed and arranged as herein described, and in combination therewith, the vibrating lever for drawing the slide back, as above represented. Second, I claim the hollow tooth, having a double shank, constructed in the manner and for the purpose before stated. Third, I claim the tube running down into the hollow tooth, so as to allow it to be raised and lowered, combined and arranged as herein set forth. Fourth, I claim the arm or crane for making the furrows, constructed and arranged in the manner and for the purpose before described."

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4. For an *Improvement in Valves for Stoves;* Henry Stanley, West Poultney, Vermont, June 11.

Claim.—" Having thus fully described the nature of my invention, and shown the manner in which the same operates, what I claim therein as new, and desire to secure by letters patent, is the manner in which I have arranged the three valves or dampers, as herein described and represented, and combined the same with the heated air chamber below an elevated oven, so that by the movement of one of them, the three shall operate simultaneously, as herein set forth; and this I claim whether said valves are connected together, and combined with the elevated oven precisely in the manner described, or in any other which is substantially the same, producing a like effect upon the same principle."

5. For an *Improvement in Water Wheels;* Esau and Jacob Whitney, and William F. Card, Burns, New York, June 11.

Claim.—"What we claim as our invention and improvement, and desire to secure by letters patent, is the construction and arrangement of the buckets on the wheel by making them nearly of a sickle or falciform as herein set forth, in combination with a scroll or shute in which it turns in closing said wheel and the various forms of discharging apertures or ventways on the periphery of the wheel, the whole being constructed and operating as herein described; using for the construction of such wheels, iron, or any other material proper for such wheels."

6. For an *Improvement in the Cap Plates of Rotary Cooking Stoves;* Maynard French, Assigned to Ira French, Cincinnati, Ohio, June 11.

Claim.—"Having thus fully described the nature of my improvement in the rotary stove, what I claim therein as new, and desire to secure by letters patent, is the casting of a wide rim or hoop, upon the stationary top plate of the stove, with a pin or pivot, rising from the centre of said plate to enter a socket in the top plate; and the casting upon the rotary top plate a narrow rim to embrace the upper edge of said wide rim, as described; these parts being claimed only in combination with each other as set forth, and not individually or separately."

7. For an *Improvement in Saddles with Spring Side Bars;* Abraham Freed, Marietta, Pennsylvania, June 11.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the before described arrangement of the spring guards in combination with the spring bars, producing double metallic spring sides to the saddle, as herein set forth—that is to say, having guards shaped and arranged as above described, and set forth, and fastened at the larger ends to the under side of the cantel—whilst the smaller ends are inserted loosely into the sheaths or pockets fastened to the cantel, and preventing the pad from touching the spring side bars as the seat of the saddle is depressed, whether combined and arranged in the manner set forth, or in any other substantially the same."

8. For *Improvements in Marine Steam Engines;* Joseph Maudslay and Joshua Field, Lambeth, England, June 11—antedated May 7, 1839—date of English Patent.

Claim.—"In conclusion, we desire to be understood that the particular features of novelty claimed by us under this patent, are, first, the adaptation of two steam cylinders to one engine in the way above described, in order that the steam may act simultaneously in both cylinders, and the pistons be made to rise and fall together, so that the combined action of both pistons may be applied to one crank on the paddle shaft. Second, the construction and adaptation of a piston with two rods working in one steam cylinder of large area, both piston rods being connected to one cross head above, in combination with the described arrangement which gives motion to the crank below, by a single connecting rod. Third, the method above described of adjusting the expansion valves of combined engines; and Fourth, the mode of constructing the beams of the framing of steam engines as hollow tubes, by the combination of plates connected by bolts or rivets."

9. For *Improvements in Rotary Steam Engines;* J. T. and B. Beale, East Greenwich, England, June 11—antedated July 17, 1841—date of English patent.

Claim.—"We claim, firstly, the adaptation of cylindrical rolling steam stops or pistons, in whatever way they may be used in rotary engines or rotary pumps, provided their construction and operation be substantially the same with that above set forth. Secondly, the introduction of non conducting or imperfectly conducting substances, between or around the eduction passages, for the purpose of preventing the eduction steam abstracting heat from the induction steam, and thereby economizing fuel."

10. For an *Improvement in the Steam Engine;* William Kelley, Pittsburg, Pennsylvania, June 18.

Claim.—"Having thus fully pointed out the nature of my improvement in the rotative reciprocating steam engine, and described the manner in which the same operates, what I claim therein as new, and desire to secure by letters patent, is the manner of combining the steam cylinder with the balanced lever, so that the two may rotate together, as herein set forth: that is to say, the cylinder and the lever being each sustained by a single revolving axis, or shaft, standing parallel to each other, and at such distance apart, as is equal to one half the length of the stroke of the piston; the piston rod being connected to the balance lever by means of a vibrating joint, constructed in the manner herein described, or in any other that is substantially the same in its operation, and thereby obviating the danger of cramping or binding as the piston reciprocates back and forth in the cylinder."

11. For an *Improvement in the Lard Lamp;* Ellis S. Archer, Philadelphia, Pennsylvania, June 18.

Claim.—"I do not claim to be the original inventor of a tube placed in the centre of the lamp, as this has heretofore been done, but what I do claim as my invention, and which I desire to secure by letters patent, is the combination of the hollow button, connected with the tube to be filled with lard, and these with the common Argand lamp, in the manner and for the purpose set forth."

12. For *Improvements in the Paddle Wheel for Propelling Vessels;* Alexander Connison, Newark, New Jersey, June 18.

Claim.—"Having thus fully described the nature of my invention and shown the manner in which the same is carried into operation, what I claim therein as new, and desire to secure by letters patent, is the manner herein set forth of forming the paddle wheels of vessels to be propelled by steam, and of combining said wheels with such vessels, so as to cause them to be operated upon by the pressure of the superincumbent water, upon the principle herein fully made known: that is to say, I claim the construction and use of propelling wheels which are to be contained within a case, or shield, of the kind herein described, and which are furnished with paddles, the faces of which form an angle with the radii of the wheel, and which are so combined with the shield, or case, which partially surrounds the wheel as to exhaust the water from a part thereof, corresponding with that marked in the accompanying drawing, and by which the pressure of the superincumbent water is made to act upon the paddles as they emerge from said case, or shield, and thereby to force the vessel forward with a power proportioned to said pressure; the whole construction and manner of operation being substantially the same with those herein fully made known."

13. For an *Improvement in the Mode of Regulating the Drag of Yarn in the Cap Spinner;* Jesse Whitehead, Manchester, Virginia, June 18.

Claim.—"Having thus fully described the nature of my improvements in the spinning apparatus, what I claim therein as new, and desire to secure by letters patent, is the so forming of the caps, when used for the spinning of filling upon spools, as that the yarn in its passage from the eye to the bottom of the cap, shall be in contact with the lower portion of the cap only, said form being given thereto for the purpose, and substantially in the manner above set forth.

"I also claim the graduating the drag of the yarn by the pressure of a ring attached to an elastic, or spring rod, the force of which is graduated to the varying diameter of the cap, as herein described. And I do hereby declare that my invention does not, in this part of it, consist in, or depend upon, the precise means by which the pressure of the ring is graduated, as this may be variously modified, but I have pointed out the arrangement of the respective parts for effecting this object which I deem the most convenient; my improvement in this part, however, consists in the use of this graduated pressure made by means of a ring, by any arrangement of the apparatus which is substantially the same as that described, and which produces a like effect by equivalent means."

14. For a *Machine for Cutting Laths, Staves, &c.;* Ebenezer Day, Grand Detour, Illinois, June 18.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the arrangement of the spring pannel in combination with the upper bar for gauging and sustaining the bolt, and for throwing the pannel towards the cutter after the knife has passed through the bolt to prevent the board falling down between the table and cutter, or knife, as before described."

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15. For an *Improvement in the Wind Mill;* John R. Remington, Aberfoil, Alabama, June 18.

Claim.—" What I claim as my invention, and which I desire to secure by letters patent, is the combination of the revolving concentrating guides with the centre revolving wheels, as before described."

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16. For an *Improvement in the Self-adjusting Carriage Lock;* William Clayton, Marshalton, Pennsylvania. Assigned to Samuel Guss, Westchester, Pennsylvania, June 18.

Claim.—' What I claim as my invention, and which I desire to secure by letters patent, is causing the rubbers on the ends of the vibrating sliding bar to traverse, and press against segments of the circumference of wheels, always at the same distance from the centres thereof as the carriage body rises and falls vertically, by means of the aforesaid combination of branched arms and circular clasps, sliding boxes, and connecting bar, and to the vibrating axle, said axle moving horizontally in the segment of a circle described from the centre of the permanent box of the same; whether the parts for producing the above effect be arranged precisely in the manner above stated, or in any other mode substantially the same."

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17. For *Improvements in the Saw Mill;* Lemuel Hedge and Edwin F. Johnson, New York City, June 18.

Claim.—" We claim and desire to secure by letters patent, the following improvements:

" First—The apparatus, self-acting, or operated by hand, by which the saws, after having completed a cut one way through the timber, are moved in the direction of their axes the requisite distance, suited to the thickness of the stuff sawed before commencing the cut in the opposite direction; that is to say, we claim the graduated racks on the saw frames, and sliding bolt, in combination with the saws, as herein described.

" Second—The mode by which the pressure of the driving belt upon the saw pulleys, is made to bear upon a thimble or tube enclosing the saw arbors, and not upon the arbors themselves, as herein described.

" Third—The mode of communicating the motion from the saw pulleys, so as to produce a progressive motion in the saws and the frame which supports them, or in the platform on which the timber to be sawed rests, in combination with the mode of changing or reversing that motion in the intervals of completing and commencing the cut each way, by an apparatus self-acting, or worked by hand, as herein described."

18. For an *Improvement in the Steam Boiler;* L. E. Hopkins, New York City, June 18.

Claim.—"I claim the particular manner of constructing the flues and water spaces in radiating sections, or compartments, and of combining the same with the other parts, as described and represented; by which construction and arrangement the said spaces are in the same number of divisions, rendered more convenient to enter, repair, or clean, whilst a larger surface is exposed to the action of the fire than when the flue spaces consist of round tubes, as heretofore."

19. For an *Improvement in the Machine for Cutting and Slitting Tortoise Shell;* William Redheffer, Penn Township, Pennsylvania, June 18.

Claim.—"What I claim, is the mechanical combination and arrangement of the saw, with the mode of holding the pieces on the carriage, for slitting tortoise shell, as herein described."

20. For *Improvements in the Machine for Spinning, Twisting, and Curling Hair;* Hiram Burnham, New York City, June 22.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of giving the first twist, or kink, to the hair, by passing round the spiral worm, in going through the first conical pulley, as described.

"I also claim the spiral, around which the hair passes, in combination with the conical pulley, and also with the main pulley and flyer, for the purpose and in the manner described."

21. For *Improvements in the method of Tapping or Boring Pipes under Hydrostatic Pressure;* H. Ariel Norris, New York City, June 22.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the boring, tapping, and making conducting attachments to water or other pipes, while under hydrostatic pressure, by means of a *close chamber*, within which the drill, tap, and ferulet are operated, according to the principles herein set forth, and by which the workman is protected during the work, from the flow of water, or other fluid, from the pipes.

"I also claim the combination of essential parts, such as the chamber, the lid, and the valve, by which that form of machine herein described is made efficient."

22. For an *Improvement in Seraphines and other Reed Musical Instruments;* James A. Bazin, Canton, Massachusetts, June 22.

Claim.—"Having thus described my improvement, I shall claim the manner of arranging the wind chest, or connecting it with the reservoir bellows, as herein before described: that is, by making the intervening top part of some flexible material, by the vibration of which the tone is greatly increased; and hinging the wind chest to the bar, as set forth, so as to allow of said wind chest's being raised, in order to move the key-board, or of being turned back, for the purpose of turning or repairing the reeds, without disconnecting it from the reservoir bellows.

"Also, the manner of changing the pitch of the instrument, by the movable key-board, by means of which music can be transposed from one key into any other, without altering the fingering.

"Also, the manner of softening the tone of the instrument, by diminishing the dip of the keys, and by that means the quantity of wind which passes through the reed plates, the whole being substantially as above set forth."

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23. For an *Improvement in the Hydrant Cock;* Levi Magers, F. D. Davis, and W. Dukehart, Baltimore, Maryland, June 22.

We omit the claim because of its dependence on the drawings.

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24. For an *Improvement in the Smut Machine, for cleaning Wheat;* John Wilson, Gentsville, South Carolina, June 22.

Claim. —"What I claim as my invention, and desire to secure by letters patent, is the grain wheel, constructed substantially as herein before stated, in combination with the fan, in the manner and for the purpose set forth. I also claim the box having partitions, in combination with the fan and grain wheel, as herein specified."

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25. For an *Improvement in the Spark Arrester for Locomotive Chimneys;* Jona. Hodges, Taunton, Massachusetts, June 22.

Claim.—"I claim the arrangement of the spiral slots, or spark arresters, in combination with the cylinder and guard, in the manner and for the purpose above set forth."

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26. For a *Machine for Turning Boot Legs;* Joseph H. Sandford, Hopewell, New York, June 22.

We are under the necessity of omitting this claim, as it could not be understood without drawings.

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27. For an *Improvement in the Gas Meter;* C. F. Brown, Baltimore, Maryland, June 22.

We omit this claim for the same reason as the previous one.

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28. For an *Improvement in the Furnace for Smelting Pig or Scrap Iron;* John C. McManaway, Scioto, Ohio, June 22.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the addition of a door, or doors, to a close fire run-out, or refinery, whereby access can at any time be had to the interior, and the bottom renewed or repaired, or large chunks of iron put in, or for any other purpose, without the necessity of removing or deranging any other part of the furnace."

29. For an *Improvement in the Cultivator;* Barnabas Langdon, Troy, New York, June 22.

Claim.—"What I claim and desire to secure by letters patent, is the standard, with its wings, as above described, and in combination therewith I claim the angular double share, or weed cutter, and the portable mould-boards; and also the upright cutters, with the plates to which they belong, all as above described."

30. For an *Improvement in Drawers for Furniture;* Oliver Jenkins, Boston, Massachusetts, June 22.

Claim.—"Having thus described my invention, I shall claim constructing the bottom of the drawer with a groove in its centre, running from the front to the rear of the same, and the frame or case thereof, with a tongue which shall correspond to said groove, as set forth, and which, when the drawer is inserted in the case, shall enter the groove, and guide the drawer in its movements to and fro, the whole being arranged substantially in the manner and for the purposes herein above explained."

31. For an *Improvement in the Plough Beam;* Joel Houghton, Ogden, New York, June 22.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is constructing the beam of a plough in parts, or, in other words, to throw it apart, or into parts, centrally, so as to increase the strength of the plough beam, without increasing the weight in proportion—the manner of attaching the cutter to it, and the mode of fastening the beam and standard together, thus doing away the clogging of the plough and the perishableness of the beam."

32. For an *Improvement in the Bee Palace;* Henry Hiser, Wooster, Ohio, June 27.

Claim.—"What I claim as constituting my invention, and which I desire to secure by letters patent, is the combining with the respective compartments, a central, vertical opening, around which opening the respective compartments are situated, there being apertures from said compartments leading into, and from, said vertical opening, which apertures are governed by slides, in the manner and for the purpose set forth.

"I also claim, in combination with said central, vertical opening, the manner in which I have arranged and combined the several apertures and slides, by which a communication is established, or cut off, between any part of the structure; the whole being constructed substantially in the manner set forth, whilst such variations may be made therein, as may be dictated by fancy or convenience, whilst the distinguished features above claimed remain unchanged."

33. For an *Improvement in the Steam Generator;* I. N. Lesh, S. W. Lesh, J. Deardorff, and Z. Beeson, Hagerstown, Indiana, June 27.

Claim.—"What we claim as our invention, and which we desire to secure by letters patent, is the combination of the spiral tubular generator and receiver, with the furnace and reflector, as described."

34. For *Improvements in Melting and Rendering Tallow and other concrete fatty substances;* L. Montrop, Baltimore, Maryland, June 27.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combined use of the steam, introduced into the kettle in which the tallow is melted, and around it between the kettles, thus melting the tallow under high pressure, in the manner above described. I also claim, in combination with this apparatus, the hot well, constructed and arranged as herein set forth."

35. For an *Improvement in the Cooking and Heating Stove;* Andrew Walker, Jr., Unity, New Hampshire, June 27.

Claim.—"I claim as my invention, and ask a patent for the combination of a gas generating apparatus, with a stove, in the manner, and by the method, structure, and arrangement of its parts, as above described."

36. For *Improvements in the Power Looms for Weaving Carpets;* Thomas Flint, Boston, Massachusetts, June 27.

Claim.—"I claim the forming and using of two or more race ways on one race beam, in combination with two or more shuttle boxes at each end of said beam, one in the rear of the other; and this I claim whether one or more of these boxes be made to receive two or more shuttles, and to rise and fall vertically, for that purpose, and whether the cylindrical shuttle box herein described, be employed or not; the division between said races being formed by means of a comb, the teeth, needles, or points of which are alternately raised and retracted, substantially in the manner and for the purpose set forth. I am aware that a comb furnished with teeth or needles, and operated in a manner somewhat resembling that above described, has been used in looms for weaving what is denominated lapped goods—the needles or teeth being employed in this case, to protect the goods from the action of the shuttles in their passage along the race, but not forming, thereby, a double race, as in my loom. I do not therefore claim the use of said comb or needles, excepting in combination with my double race, furnished with shuttle boxes, one behind another, as set forth.

"I claim the manner of rotating and vibrating the cylindrical shuttle box, by means of the chain wheels, levers, ratchet wheels, sliding frame and sliding rods connected with the Jacquard machine, and with each other, so as to co-operate in producing the desired effect, as set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

Objections to the Theories severally of Franklin, Dufay, and Ampere, with an effort to explain Electrical Phenomena, by Statical, or Undulatory, Polarization.[*] *By* ROBERT HARE, M. D., *Emeritus Professor of Chemistry in the University of Pennsylvania.*[†]

1. It appears from the experiments of Wheatstone, that the discharge of a Leyden jar, by means of a copper wire, takes place within a time so small, that were the transfer of a fluid from the positive to the negative surface requisite for its accomplishment, a current having a velocity exceeding two hundred thousand miles in a second would be necessary.

2. The only causes for the velocity of an electric current, according to Franklin, are the repulsion between the particles of the electric fluid, of which it has been assumed to consist, and the attraction between those particles and other matter. These forces are alleged to concur in distributing the supposed fluid throughout space; whether otherwise void, or partially occupied by conducting solids or fluids. Hence, when between two or more spaces, surfaces, or conducting masses, there is an unequal distribution of the electric fluid, the equilibrium is restored whenever a communication is opened, by means of a sufficiently conducting medium. Agreeably to this view of the subject, there seems to be a resemblance between the supposed effort of the electrical fluid to attain a state of equable diffusion, and that which would exist in the case of a gas confined in adjoining receivers, so as to be more dense within one than within the other; for, however the subtility of the supposed electric fluid may exceed that of any gas. there seems to be an analogy as respects the processes of diffusion which must prevail. But on opening a communication between cavities in which any aëriform fluid exists, in different degrees

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[*] Agreeably to Faraday's researches, and general experience, we have reason to believe that all particles of matter are endowed with one or the other of two species of polarity. This word polarity conveys the idea that two terminations in each particle are respectively endowed with forces which are analogous, but contrary in their nature; so that of any two homogeneous particles, the similar poles repel each other, while the dissimilar attract; likewise when freely suspended they take a certain position relatively to each other, and on due proximity, the opposite polar forces, counteracting each other, appear to be extinct. When deranged from this natural state of reciprocal neutralization, their liberated poles react with the particles of adjacent bodies, or those in the surrounding medium. Under these circumstances, any body which may be constituted of the particles thus reacting, is said to be polarized, or in a state of polarization.

[†] Read before the Academy of Natural Sciences, and with their permission published in the Medical Examiner: republished with corrections and additions by the author.

of condensation; evidently the density will diminish within one cavity and will augment within the other with a rapidity, which, however great at the commencement, must decrease and become evanescent with the diversity of condensation to which it owes its existence. Far from taking place in an analogous manner, electrical discharges are effected with an extreme suddenness, the whole of the redundancy being discharged at once, in a mode more like the flight of a bullet, projected with infinite velocity, than that of a jet varying in celerity from a maximum to a minimum.

3. So far, in fact, is an electrical discharge from displaying the features which belong to the reaction of a condensed elastic fluid, that agreeably to the observations of our distinguished countryman Henry, the result is more like the vibrations of a spring, which, in striving to regain its normal position, goes beyond it. The first discharge between the surfaces of a Leyden jar is not productive of a perfect equilibrium. The transfer of different polarities goes beyond the point of reciprocal neutralization, producing a state, to a small extent, the opposite of that at first existing; and hence a refluent discharge ensues, opposite in direction to the primary one. But even this does not produce an equilibrium, so that a third effort is made. These alternate discharges were detected by means of the magnetism imparted to needles exposed in coils of copper wire.*

4. Supposing one or more rows of electrical particles, forming such a filament of electricity as must occupy the space within a wire of great length, to be made the medium of discharge to a Leyden jar; agreeably to the hypothesis of one fluid, the electrical filament must be attracted at one end of the wire, and propelled at the other, as soon as its terminations are brought into due communication with the coatings of the jar. Yet the influence of the oppositely charged surfaces of the jar, cannot be conceived to extend to those portions of the electricity which are remote from the points of contact, until they be reached by a succession of vibrations. Hence it is inconceivable, that every particle in the filament of electric matter can be made at the same time to move, so as to constitute a current having the necessary velocity and volume to transfer, instantaneously, the electricity requisite to constitute a charge. Even the transmission of the impulses, in such an infinitesimal of time, seems to be inconceivable.

5. In reply to these objections, it has been urged by the Franklinians, that a conductor being replete with electricity, as soon as this fluid should be moved at one end, it ought to move at the other. This might be true of a fluid if incompressible, but could not hold good were it elastic. A bell wire moves at both ends when pulled only at one; but this would not ensue were a cord of gum elastic substituted for the wire.

6. But if the flow of one fluid, with the enormous velocity inferred, be difficult to conceive, still more must it be incomprehensible that two fluids can rush with similar celerity, from each surface of the jar, in opposite directions, through the narrow channel afforded by a wire; especially as they are alleged to exercise an intense affinity; so that it

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* Communicated to the American Philosophical Society.

is only by a series of decompositions and recompositions that they can pass each other. That agreeably to the theory of Dufay, equivalent portions of the resinous and vitreous fluids must exchange places during an electrical discharge, will appear evident from the following considerations:

7. One surface being redundant with vitreous and deficient commensurately of resinous electricity, and the other redundant with the resinous and deficient of the vitreous fluid, it is inevitable that to restore the equilibrium, there must be a simultaneous transfer of each redundancy to the surface wherein there is a deficiency of it to be supplied. If after decomposing a large portion of the neutral compound previously existing on the surfaces of the jar, and transferring the ingredients severally in opposite directions, so as to cause each to exist in excess upon the surface assigned to it, were the redundancies, thus originated, to be neutralized by meeting in the discharging rod, neither surface could recover its quota of the electrical ingredient of which it must have been deprived agreeably to the premises.

8. This calls to mind the fact, that no evidence has been adduced of the existence of any tertium quid, arising from the union of the supposed electricities, founded on any property displayed by their resulting combination in the neutral state. It must, if it exist, constitute an anomalous matter, destitute of all properties, and of the existance of which we have no evidence, besides that founded on the appearance and disappearance of its alleged ingredients.

9. But however plausibly the discharges consequent to making a conducting communication from one electrified mass or surface to another mass or surface in an opposite state, may be ascribed to accumulations either of one or of two fluids; neither according to one theory nor the other, is it possible to account satisfactorily for the stationary magnetism with which steel may be endowed, nor the transitory magnetism, or dynamic power of induction, acquired by wires transmitting galvanic discharges.

10. For the most plausible effort which has been made for the purpose of reconciling the phenomena of electro-magnetism with the theory of two fluids, or with that of one fluid, so far as these theories are convertible, we are indebted to Ampere.

11. According to the hypothesis advanced by this eminent philosopher, the difference between a magnetized and an electrified body is not attributable to any diversity in the imponderable matter to which their properties are respectively due, but to a difference in the actual state or distribution of that matter. Statical polarity is the consequence of the unequal distribution of the two electric fluids whose existence he assumes; while magnetical polarity is the consequence merely of the motion of those fluids, which, in magnets, are supposed to gyrate in opposite directions about each particle of the mass. These gyrations are conceived to take place only in planes at right angles to the axis of the magnet; so that in a straight magnet, the planes of the orbits must be parallel to each other.*

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* The words gyration, vortex, and whirl, are considered as synonymous, and used indifferently to avoid monotony.

12. The aggregate effect of all the minute vortices of the electrical fluids, in any one plane, bounded by the lateral surfaces of the magnet, is equivalent externally to one vortex, since, in either case, every electric particle on that surface will so move as to describe tangents to a circle drawn about the axis of the magnet. When the electrical vortices of the pole of one magnet conflict in their direction with those of another, as when similar magnetic poles are approximated, repulsion ensues; but if the vortices are coincident in direction, as when dissimilar poles are near, attraction takes place. When a current through a galvanized wire * concurs in direction with the magnetic vortices as above described, attraction ensues; repulsion resulting when it does not so concur. Hence, the magnet, if movable, will strive to assume a position in which its electrical currents will not conflict with those of the wire on one side more than on the other: also the wire, if movable, will tend so to arrange itself as to produce the same result, which can arrive only when the needle is at right angles to the wire, and its sides consequently equi-distant therefrom.

13. Electric currents will produce magnetic vortices, and, reciprocally, magnetic vortices will produce electric currents. Hence the magnetism imparted to iron by galvanized spirals, and the Faradian currents produced by magnetized iron within spirals not galvanized.

14. Ampere's theory has, in a high degree, the usual fault of substituting one mystery for another; but, on the other hand, it has, in an equally high extent, the only merit to which any theory can make an indisputable claim: I mean that of associating facts so as to make them more easy to comprehend and to remember, enabling us, by analogy, to foresee results, and thus affording a clue in our investigations. Evidently, the author of this theory was guided by it, in his highly interesting and instructive contrivances; and Professor Henry ascribes his success in improving the electro-magnet, to the theoretic clue which he had received from Ampere.

15. Nevertheless, the postulates on which this Amperian hypothesis is founded, appear to me unreasonable. They require us to concede that about every atom of a permanent magnet a process is going on, analogous to that generally admitted to exist in a galvanic circuit, where two fluids pass each other in a common channel by a series of decompositions and recompositions. In the galvanic circuit this process is sustained by chemical reaction; but without any co-enduring cause, how is it to be sustained permanently in a magnet? Is it reasonable to assume that the heterogeneous constituents of an imaginary tertium quid are perpetually separating only to re-unite?

16. In cases of complex affinity, where four particles A B C D are united into two compounds A B, C D, it is easy to conceive that, in obedience to a stronger affinity, A shall combine with C, and B with D: but, without any extraneous agency, wherefore. in any one compound, should a particle A quit one particle B, in order to unite with

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* I consider a wire as galvanized, when it is made the medium of the discharge from a galvanic battery.

another particle of the same kind; or wherefore should any one, B, quit one A, in order to combine with another A.

17. That such a process should take place in consequence of the inductive agency of a similar process already established in a magnet or galvanized wire were difficult to believe: but it would seem utterly incredible that the most *transient* influence of such induction, should be productive of such permanent electrolytic gyration as has been above specified. Moreover, it is inconceivable that the particles of any matter should, as required by this hypothesis, *merely by being put into motion*, acquire a power of reciprocal repulsion, or attraction, of which it were otherwise destitute.

18. The vortices being assumed to take place about each atom, cannot severally occupy an area of greater diameter than can exist between the centres of any two atoms. Of course, the gyratory force exercised about the surface of a magnet by the aggregrate movements of the vortices, cannot extend beyond the surface more than half the diameter of one of the minute areas of gyration alluded to. Wherefore, then, do these gyrations, when similar in direction, from their concurrence approach each other; when dissimilar in direction from contrariety, move away, even when situated comparatively at a great distance?

19. I should consider Ampere's theory as more reasonable, were it founded upon the existence of one fluid; since, in that case, vortices might be imagined without the necessity of supposing an endless and unaccountable separation and reunion of two sets of particles; not only devoid of any property capable of sustaining their alleged opposite gyrations, but actually endowed with an intense reciprocal attraction which must render such gyrations impossible. But even if grounded on the idea of one fluid, this celebrated hypothesis does not seem to me to account for the phenomena which it was intended to explain. If distinct portions of any fluid do not attract or repel each other when at rest, wherefore should they either attract or repel each other when in motion. Evidently mere motion can generate neither attraction nor repulsion. Bodies projected horizontally gravitate with the same intensity, and consequently, in any given time, fall to the earth through the same perpendicular distance, whether moving with the celerity of a cannon ball, or undergoing no impulse excepting those arising from their own unresisted weights.

20. The objections which are thus shown to be applicable in the case of liquids, of which the neighboring particles are destitute of the reaction requisite to produce the phenomena requiring explanation, must operate with still greater force when ethereal fluids are in question, of which the properties are positively irreconcilable with the phenomena. According both to Franklin and Dufay, bodies, when similarly electrified, should repel each other: yet in point of fact, collateral wires, when subjected to similar voltaic discharges, and of course similarly electrified, become reciprocally attractive, while such wires, when dissimilarly electrified by currents which are not analogous, become reciprocally repulsive.

21. Agreeably to Ampere, an iron bar, situated within a coil of

wire subjected to a galvanic current, is magnetized, because the current, in the wire, is productive of an electrical whirlpool about every particle of the metal. When the iron is soft, the magnetism, and of course the gyrations of which its magnetism consists by the premises, cease for the most part as soon as the circuit through the coil is broken; but when the iron is in the more rigid state of hardened steel, the gyrations continue for any length of time after the exciting cause has ceased.

22. This theory does not explain wherefore the hardening of the steel should cause the gyration to be more difficult to induce yet more lasting when its induction is effected. Evidently the metallic particles must take some part in the process; since it is dependent, for its existence and endurance, upon their nature and their state. Yet no function is assigned to these particles. In fact, it is inconceivable, either that they can participate in, or contribute to, the supposed gyration.

23. The electrical fluid in an iron bar, cannot form a vortex about each particle, all the vortices turning in one direction, without a conflict between those which are contiguous. In order not to conflict with each other, the alternate vortices would have to turn in different directions, like interlocking cog-wheels in machinery. But in that case, if magnetism be due to currents, the magneto-inductive influence of one set would neutralize that of the other. Again, how can a current, excited by a battery in one circuitous conductor, cause, by dynamic induction, a current in the *opposite direction*, through another conductor parallel to the first, but insulated therefrom? How can a current of quantity in a ribbon coil, give rise to one of intensity in a coil of fine wire, rushing of course with a velocity commensurate with the intensity thus imparted?

24. From the preceding considerations, and others which will be stated, it follows, that it has been erroneously inferred that the only difference between galvanic and frictional electricity is dependent on quantity and intensity. It must be evident that there is a diversity in the nature of these affections of matter, sufficient to create a line of demarcation between them.

25. Having stated my objections to the electrical theories heretofore advanced, it may be proper that I should suggest any hypothetical views which may appear to me of a character to amend or supersede those to which I have objected. But however I may have been emboldened to point out defects which have appeared to me to be inherent in the theories heretofore accredited, I am far from presuming to devise any substitute which will be unobjectionable. I am fully aware that there is an obscurity as respects the nature and mutual influence of chemical affinity, heat, light, electricity, magnetism and vitality, which science can only to a minute extent dispel.

26. The hypothesis which I now deem preferable, is so much indebted to the researches and suggestions of Faraday and others, that, were it true, I could claim for myself but a small share of the merit of its origination. That sagacious electrician employs the following

language: "*In the long continued course of experimental inquiry, in which I have been engaged, this general result has pressed upon me constantly, namely, the necessity of admitting two forces or directions of force, combined with the impossibility of separating these two forces or electricities from each other.*"—*Experimental Researches,* 1163.

27. Subsequently (1244) after citing another proof of the inseparability of the two electrical forces, he alleges *it to "be another argument in favor of the view that induction and its concomitant phenomena depend upon* a polarity of the particles of matter!"

Supposed grounds for a Theory.

28. The grounds upon which I venture to advance a theory, are as follows:—

"The existence of two heterogeneous polar forces acting in opposite directions, and necessarily connate and co-existent; yet capable of reciprocal neutralization, agreeably to the authority of Faraday and others: the polarity of matter in general, as displayed during the crystalization and vegetation of salts: also as made evident by Faraday's late researches, and the experiments and observations of Hunt: the very small proportion of the space in solids, as in the instance of potassium and other metal, which can be occupied by the ponderable atoms; while agreeably to the researches and speculations of Faraday (rightly interpreted), the residual space must be replete with imponderable matter. The experiments and inferences of Davy and others, tending to sanction the idea that an imponderable ethereal fluid must pervade the creation: the perfect identity of the polarizing effects, transiently created in a wire by subjection to a galvanic discharge, with those produced by the permanent polarizing power of a steel magnet: the utter heterogeneousness of the powers of galvanic and frictional electricity, as respects ability to produce sparks before contact, and likewise of the polarities which they respectively produce: the sounds observed severally, by Henry and Mairran, as being consequent to making and breaking a galvanic circuit through a conductor, or magnetizing or demagnetizing by means of surrounding galvanized coils."

Proofs of the existence of an enormous quantity of Imponderable Matter in Metals.

29. It has been most sagaciously pointed out by Faraday, that four hundred and thirty atoms which form a cube of potassium in the metallic state must occupy nearly six times as much space as the same number of similar atoms fill, when existing in a cube of hydrated oxide of potassium of the same size; which, besides seven hundred metallic atoms, must hold seven hundred atoms of hydrogen and fourteen hundred of oxygen, in all two thousand eight hundred atoms; whence it follows that, in the metallic cube, there must be *room* for six times as many atoms as it actually holds.

30. With all due deference, I am of opinion that this distinguished philosopher has not been consistent in assuming that, agreeably to the

Newtonian idea of ponderable atoms, the space in potassium not replete with metal must be vacant; since, according to facts established by his researches, or resulting therefrom, an enormous quantity, both of the causes of heat and of electricity, exists in metals. Moreover, agreeably to his recent speculations, those causes must consist of material, independent, imponderable matter, occupying the whole of the space in which their efficacy is perceptible. To the evolution of the imponderable matter thus associated, the incandescence of a globule of potassium on contact with water, may be ascribed, since it is the consequence of the displacement of such matter by the elements of water, which, in replacing it, converts the metal into the hydrated oxide called caustic potash.

31. The existence both of the causes of electricity and heat in metals, is likewise confirmed by the fact, that the inductive influence of a magnet is sufficient to cause all the phenomena of heat, electrolysis, and magnetism, as exemplified by the magneto-electric machine. The existence of the cause of heat in metals is also evident from the ignition of an iron rod when hammered, or the deflagration of wire by the discharge of a Leyden battery.

32. The superiority of metals as electrical conductors, may be the consequence of the pre-eminent abundance of imponderable matter entering into their composition, as above alluded to in the case of potassium.

33 Graham, in his Elements, treating of electricity, alleges that the "great discoveries of Faraday have completely altered the aspect of this department of science, and suggests that all electrical phenomena whatever involve the presence of matter." Unless the distinguished author, from whom this quotation is made, intended to restrict the meaning of the word matter to ponderable matter, there was no novelty in the idea that electrical phenomena involve the presence of matter, since the hypotheses of Franklin and Dufay assume the existence of one or more imponderable material fluids. But, on the other hand, if the meaning of the word *matter* is only to comprise that which is ponderable, the allegation is inconsistent with the authority cited. According to the researches of Faraday, there is an enormous electrical power in metals, and according to his speculations, such powers must be considered as imponderable material principles, pervading the space within which they prevail, independently of any ponderable atom acting as a basis for material properties; the existence of such atoms being represented as questionable.

Electrical Phenomena attributed to Stationary, or Undulatory, Polarization.

34. It having been shown that in electrical discharges there cannot reasonably be any transfer of matter, so as to justify the idea of their being effected either by one current or by two currents, the only alternative seems to be that the phenomena are due to a progressive affection of the conducting medium, analogous in its mode of propagation to waves, as in the case of liquids, or the aërial or ethereal undulations to which sound and light are ascribed. (1, 2, 3, &c., &c.)

35. The idea intended to be conveyed by the word wave, as applied in common to the undulatory affections above mentioned, and that which is conceived to be the cause of the phenomena usually ascribed to one or more electrical currents, requires only that there should be a state of matter, which, while it may be utterly different from either of those which constitute the waves of water, light, or sound, may, nevertheless, like either, pass successively from one portion of a mass to another.

36. The affection thus designated may be reasonably distinguished from other waves, as a *wave of polarization*, since the wire acts, so long as subjected to the reiterated discharges of a voltaic series, as if it were converted into innumerable small magnets, situated like tangents to radii proceeding from its axis.

37. But if a polarizable medium be requisite to electrical discharges, since they pass through a space when devoid of *ponderable* matter, there must be some *imponderable* medium through which they can be effected. Hence we have reason to infer that there is an imponderable matter existing throughout all space, as well as within conductors, which is more or less the medium of the opposite waves essential to electric discharges. Quoting his own language, Davy's experiments led him to consider "that space, (meaning void space,) where there is not an appreciable quantity of this matter, (meaning ponderable matter,) is capable of exhibiting electrical phenomena:" also that such phenomena "are produced by a highly subtile fluid or fluids." Moreover, that "it may be assumed, as in the hypothesis of Hooke, Euler, and Huygens, that an ethereal matter susceptible of electrical affections fills all space."

38. Agreeably to the suggestions above made, all ponderable matter which is liable to be electrified *internally* by electrical discharges, may be considered as consisting of atoms composed of imponderable ethereo-electric particles in a state of combination with ponderable particles, analogous to that which has been supposed to exist between such particles and caloric when causing expansion, liquidity, or the aëriform state. Atoms so constituted of ethereal and ponderable particles, may be designated as ethereo-ponderable atoms.*

39. A quiescent charge of frictional electricity, only affecting the superficies of any ponderable mass with which it may be associated, and having no influence upon the component ethereo-ponderable atoms severally, is not to be ascribed to redundancies or deficiencies of the ethereal matter, but to different states of polarization produced in different sets of the particles of such matter existing about the

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* Pouillet suggests that when the passage of a ray of light through glass, is influenced by a powerful magnet, agreeably to the experiments of Faraday, "consistently with the undulatory theory of light, it is the ether of the body submitted to the experiment, which would be modified by the magnetism, and that it would be very difficult to recognise whether it is modified without any participation of the ponderable matter with which it is so intimately connected." Thus the existence of matter, composed of ethereal as well as ponderable particles, is sustained by all the evidence which has been brought to uphold the undulatory theory of light.—*L. E. & D. Phil. Mag. &c. for* 1846, *Vol. 28th, page* 335.

electrifiable bodies.* During the action of an electrical machine, these particles are polarized by the opposite polarities transiently induced in the surfaces subjected to friction; one set of particles going with the electric, the other remaining with the rubber.

40. The particles thus oppositely polarized, severally divide their appropriate polarities with other ethereal matter surrounding the conductors, and this, when insulated, is retained until a further polarization results from the same process. Thus are the ethereo-electric atmospheres respectively surrounding the positive and negative conductors oppositely polarized, and consequently charged to the degree which the machine is competent to induce. Under these circumstances, if a rod be made to form between them a conducting communication, by touching each conductor with one of its ends, the polarities of the ethereo-electric atmospheres by which they are severally surrounded, propagate themselves, by a wave-like process, over, and more or less through, the rod, according to its nature and dimensions, so as to meet midway, and thus produce reciprocal neutralization.

41. When the oppositely polarizing waves, generated by friction, as above described, are by means of a conducting communication transmitted to the surfaces of a coated pane, the two different portions of the electro-ether, there existing, are severally polarized in opposite ways, one being endowed with the properties usually called vitreous, or positive, the other with those usually called resinous, or negative. In fact, the two polarized atmospheres thus created, may be conveniently designated as the *"two electricities,"* and alluded to in the language heretofore employed in treating of phenomena, agreeably to the hypothesis which assumes the existence of heterogeneous fluids, instead of heterogeneous polarities.

42. Of course it will follow, that the oppositely polarized ethereal atmospheres thus produced, one on each surface of the electric which keeps them apart, must exercise towards each other an attraction perfectly analogous to that which has been supposed to be exercised by the imaginary heterogeneous electric fluids of Dufay. The electro-ether † being elastic, a condensation over each of the charged

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* The word statical, has been used to designate phenomena which are the effects of electricity when at rest, as when accumulated upon conductors or the surfaces of panes or jars.* Phenomena which are supposed to arise from electricity in motion (forming a current), are designated as dynamic. Thus when charging one side of a pane, produces the opposite state in the other, the effect upon the latter is ascribed to *statical* induction; but when a discharge of electricity through one wire, causes a current in another, forming an adjacent circuit, the result is ascribed to *dynamic* induction. This method of designation is employed whether the alleged current be owing to electricity generated by friction, as in the case of a machine, or generated by chemical reaction, as in the case of a galvanic battery. A good word is wanting to distinguish electricity, when produced by friction, from electricity produced by galvano-chemical reaction: for want of a better, I will resort to that employed by Noad *(frictional)*, which has the advantage of being self-explanatory.

† As the word ether is used in various senses, the syllables *"electro"* being prefixed, serve to designate that which is intended.

* See my Compendium for Treatise on Electricity, pages 26—29.

surfaces, proportionable to the attractive force, must ensue; while over the surface of an electrified conductor, the similarly polarized atoms not being attracted by those in an oppositely polarized atmosphere beneath the surface, tend, by their reciprocally repulsive reagency, to exist further apart than in a neutral state. Hence, the electro-ether, as it exists over the surface of an insulated conductor, is rendered rarer, while, as existing over the surfaces of charged panes or Leyden jars, it must be in a state of condensation.* And, consequently, while the space perceptibly electrified by the charge of a conductor, for equal areas and charging power, is much more extensive than the space in which the charge of a coated pane is perceptible, the striking distance being likewise much greater; yet upon any body successively subjected to a discharge from each, the effect will be more potent when produced by means of the pane.

Ignition, Electrolysis, and Magnetism, Secondary Effects of Frictional Discharges; or, in other words, of Polarizing Electro-ethereal Waves.

43. In proportion as a wire is small in comparison with the charge which it may be made the means of neutralizing, the conducting power seems to be more dependent on the sectional area,† and less upon the extent of surface. The reciprocal repulsion of the similarly polarized ethereal particles must tend always to make them seek the surface, but at the same time their attraction for the ethereo-ponderable particles composing the wire has the opposite effect, and tends to derange these from their normal polar state of quiescence. Commensurate with the extent in which this state is subverted, is the resulting heat, electrolytic power, and electro-magnetic influence. The phenomena last mentioned, are, however, secondary effects consequent to the participation of the ethereo-ponderable matter in the undulations resulting from the statical discharge.

44. Such effects, making allowance for the extreme minuteness of the time occupied by the process, are probably, in all cases, proportional to the degree in which the ponderable matter is affected, up to the point at which it is dissipated by deflagration; but the duration of a statical discharge being almost infinitely minute for any length of coil which can conveniently be subjected thereto, the electro-magnetic and other effects of a statical discharge, are not commensurate with the intensity of the affection of the wire.

45. There is, in fact, this additional reason for the diversity between the electro-magnetic power of a statical discharge, as compared with that of the voltaic series: any wire which is of sufficient length and tenuity to display the maximum power of deflagration by the former, cannot serve for the same purpose in the case of the latter. Moreover, the form of a helix closely wound, so that the coatings may

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* See my communication on "*Free Electricity,*" in Silliman's American Journal of Science, Vol. III., New Series, number for May, 1847.

† The sectional area of a conductor is the area of the superficies which would be exposed by cutting it through at right angles to its axis.

touch, which is that most favorable for the reiteration of the magnetic influence of the circuit upon an iron rod, cannot be adopted in the case of statical discharges of high intensity, since the proximity of the circumvolutions would enable the ethereal waves, notwithstanding the interposition of cotton or silk, to cross superficially from one to the other, parallel to the axis of the included iron, instead of pursuing the circuitous channel afforded by the helix with the intensity requisite to the polarization of the ponderable atoms.

(To be Continued.)

A Plan for Obtaining Pure Water from the Atmosphere, for the Supply of Vessels at Sea, and other purposes. By JOHN THOMSON.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Gentlemen: — Considering the necessity of water, as drink, to the existence of man, and that much real suffering and death has occurred upon the open ocean, from the want of it, I beg leave to express my fixed opinion, that pure water for drink may be extracted from the atmosphere, in a sufficient quantity to be of some service to the maritime community, and at a sufficiently cheap rate to warrant a trial upon a large scale. My researches and experiments prove satisfactorily that the atmospheric air of every climate is more or less charged with watery vapor, according to its temperature and locality, holding in solution from $\frac{1}{30}$ to $\frac{1}{300}$ part, by weight, of water—that a cubic foot of air at 66° is capable of holding in solution about 8 grains of water—that the capacity of air for holding water increases with the temperature—and that in a tropical climate, and over the ocean, it is at all times nearly saturated with vapor. This water, which is chemically combined with the air, shows itself at all times, when subjected to a diminished temperature, independent of electricity—and hence we have dews, fogs, rain, &c., under the operations of nature. But that which must strike the attention of every person, and which proceeds from the same cause, is the drops of water that collect upon the outside of a jug of cold water on a warm summer day.

I am well aware of the process of distilling sea water, which has long been practised with tolerable success, but fuel is not always to be had; neither is the drink thus obtained, as pure as could be wished.

I have never met with any proposal for obtaining fresh water artificially, at sea, without the expense of chemicals. The plan which I am about to propose, has such advantage, and may nevertheless go under the designation of distillation, although I dispense with fire; for I propose to condense the warm air of the atmosphere by the cold water of the ocean. I have attended to the temperature of the air in different latitudes, as also to its humidity and the dew point. I have likewise observed the degrees of heat that characterize the waters of a tropical sea from others more remote from the equator, and the depths at which a given temperature of the ocean may be had, together with the currents which circulate both the ocean and the atmosphere of the globe—all of which shows much intelligence and labor in the experimentalists in these various branches of natural philosophy. But still I have to regret a want of experiments for the temperature of the ocean at smaller depths; although I find, from the many experiments that have been made by soundings, that there is a degree of cold in the ocean, (though at very great depths,) far beyond what is necessary for my purpose as a condensing medium, the obtaining of which at the surface, seems to me the only point at issue to crown my undertaking with success. Pursuing this one point, I find that the currents of the ocean, in sweeping along the bottom, are occasionally obstructed by banks, &c., which lift the cold waters up, and that even after mingling with the upper and warmer, the temperature is so much changed, that the thermometer was at one time seriously talked of as a necessary nautical instrument, for descrying danger when nearing land. The knowledge of hydraulics and hydrostatics emboldens me to say that a pipe could be let down from a float at anchor, over some well selected bank, reaching to a depth sufficient to bring up these bottom waters, and that the motion of the under current is amply sufficient to continue a circulation (as only a circulation, and not a lifting, of the waters is what is required) of the cold stream in the pipe, and through the machine, without the use of any other power—whilst a windsail could convey a continuous current of atmospheric air through the apparatus to be acted on by the water, as in a common distilling operation—the average velocity of the wind over the ocean being estimated at 18 miles per hour throughout the year.

In the summer of 1845, I instituted a series of experiments with a machine I had made, and with the results of which I was highly pleased; but other business interfering, I have never found it possible to renew my enquiries upon the subject. The worm with which I operated was of tin, a little over half an inch in diameter, and about 18 feet in length, having an inner surface of about 3¼ square feet. This pipe, being coiled, I set into a tub of water, the two ends extending above the surface. At each experiment the water in the tub was kept at a fixed temperature, and thus, with the worm immersed, we blew a current of air through the pipe, by means of a pair of common bellows. In this rude and laborious manner, we succeeded at all times in obtaining water from the atmosphere—the state of the *barometer* seemingly having no influence on this branch of philosophical enquiry. Some of these experiments were performed in the hot sunshine, and others in the shade.

I find from my notes, July 15, two trials. The condensing medium in the box was cooled by ice to 38°—the atmosphere being 83°. The produce of water, after working half an hour, was over half an ounce, or a good table-spoonful. Both trials were conducted under the same circumstances, and with equal results.

Again, August 10th—two experiments. The time of each operation was two hours. In the first, the condensing medium was spring water, at 54°, the atmosphere 77°—produce, $1\frac{15}{16}$ ounces of water. The air, after passing through the worm, was reduced to 61°, having lost 16°. Second experiment—Condensing medium reduced by ice, to 37°—atmosphere, 80°—produce, $2\frac{10}{16}$ ounces. The air at its exit, 49°, having lost 31°. Thus, from these last two experiments, I remark that it is not *proportionately* advantageous to reduce the temperature of the air to a very low degree, in passing through the worm—for observe, in the last mentioned trial, I reduced the air about double of the former, and only received $\frac{11}{16}$ by so doing, which establishes a very material point regarding practical operations on a large scale, viz: that to extract a few degrees of heat from the air of a high temperature, yields over double of the same reduction of a lower temperature; and further, that a condensing medium, such as I propose, may be obtained, and that frigorific mixtures are of little service. I do not propose to extract all the vapor that may be contained in the current of air through the machine, but only that portion contained in the higher numbers in the scale of temperature. Although I have mentioned only a few of my many experiments, I hope it will be evident that the plan is practicable, and I mention with pride, the obtaining from the hot air, under a burning sun, a full tumbler of pure water, in four hours, whilst my pipe had only the limited surface of $3\frac{1}{4}$ square feet, together with the disadvantage of an inland situation, where the moisture is more limited than at sea.

It was my original design that each ship should carry its own apparatus for obtaining fresh water, but from the conflicting statements regarding the cold existing a few feet below the surface, I have discarded the idea, and now advocate with confidence the plan which I have submitted to you.

The various currents in the ocean are likely so to affect the object at which we aim, owing to their difference of temperature, that I pointedly urge a good selection of situation. To illustrate this difference, take the Equatorial and the Guinea currents, which run parallel, but in contrary directions, upwards of 1000 miles, and differ in their temperature 10° or 12°.

I might insert a table of temperatures for both the air and the water, for all the different latitudes, but I deem it superfluous. Suffice it that the mean temperature of the air, the year round, both day and night, between the tropics, varies from 85°, which is at the equator, to about 77° at about the latitude of the tropics, and that however the thermometer may range, it is more regular over the ocean, and never rises as high at sea as on the main land.

The temperatures of the waters of the ocean, although less known, are nevertheless found to vary considerably. In the tropical seas, as well as in the temperate zones, the temperature diminishes in a geometrical progression, while the depth is taken arithmetically, and although the waters of the sea, in any latitude, or in any season, cannot exceed 86°, yet the bottom has often been found between 30° and 40°.

In conclusion, I consider a detailed proposal for further operations, having for its object the production, reproduction, or manufacture of water from the atmosphere, for the use of the shipping interest navigating the warmer seas, as inadvisable upon my part. Modifications can be made of my simple apparatus, to an indefinite extent, by concentrate tubes within each other, or otherwise, whilst the float may be of any size, so as to supply the shipping as a watering place, safe from hostile shores and circuitous routes, &c. I would only add, that if this should meet with a favorable reception, I will be happy to add anything further that may have occurred in my experiments, and omitted here.

Philadelphia, December, 1847.

A Description of Col. Long's Composite Bridge. Secured, March 10, 1845, *and Patented, November* 13, 1847.

The Composite Bridge is so called from the fact, or circumstance, that it comprehends the principles of the Brace and Suspension Bridges, patented in 1839, combined and rendered co-operative in the truss-frames of a single bridge, and is composed of two or more single, double, triple, or quadruple truss-frames, stayed, supported, and strengthened, by the aid of such transverse and lateral braces, arch braces, flooring, &c., &c., as may be deemed most suitable for these purposes. This bridge is distinguished from other bridges heretofore invented and now in use, by certain differences and combinations in the arrangements and operations of its parts, which will be duly considered in the specification.

Each truss-frame of the Composite Bridge comprises the following parts, all composed of timbers of uniform, or nearly uniform, transverse dimensions, varying from one to four inches in thickness, and from six to fifteen inches in width, their respective lengths being variable, according to the positions they respectively occupy in the truss-frames. These parts are as follows, viz:—strings and splices; main suspensor braces; posts or vertical ties; main thrust braces; brace bolsters, or brace gluts; brace keys, or wedges;—together with such arch braces; lateral and transverse braces; flooring; roofing; bolstering; trenailing, &c., as have heretofore been employed in bridge building, or may hereafter be deemed expedient in structures of this nature.

The strings and their splices are similar in all respects to those employed in the suspension bridge before mentioned. (See description, vol. xxiv., 2nd series, page 325.)

The main suspensor braces are inserted in the truss-frame, in the same manner as specified in the patent for the suspension bridge before alluded to; (see description, vol. xxiv, 2nd series, page 327;) but are so arranged in their connexion with other parts of the truss-frame, that they are enabled to act both by *tension* and by *thrust*, or by either of these forces, according to the stresses or actions to which the posts and main thrust braces of the truss frame, are subjected. These braces are so arranged that they may act alternately as main braces, and as counterbraces, according as the exigencies of the case, or the stresses upon the bridge may require the one or the other of these actions.

Note. The main suspensor braces may be rendered *contractile*, by introducing, in connexion therewith, splicing pieces, gibs, keys, &c., after the manner observed in the application of these parts to the splicings of the inferior arch braces of the brace bridge, except that they are so arranged as to reduce, instead of increasing, the length of the braces. (Pl. IV., fig. 2, vol. xxiv.)

The *posts* or *vertical ties*, instead of abutting against the strings as in the suspension bridge, or of being confined between the string pieces, by means of gibs and keys, as in the brace bridge, pass through and between the string pieces, as in the latter, and are confined by means of trenails, or other similar fastenings, passing through them and the strings. The posts occupy the same spaces between the string pieces, as those occupied by the suspensor braces, and have their extremities exteriorly of the strings, so scarfed and adjusted as to bring them respectively into close contact with the edges of the braces with which they are associated. Their operation is such as to keep the upper and lower strings of the truss frame at fixed distances asunder, obviating any and every tendency, whether to increase or diminish their distances.

Note. Whenever there is occasion to ensure and maintain the action by *tension* in the main suspensor braces (together with that by *thrust* in the main thrust braces) it is expedient to employ, in connexion with the posts, stretchers, composed of splicing pieces, gibs, and keys, &c., after the same manner as those employed in the inferior arch braces of the brace bridge, by means of which the distances between the upper and lower strings may be increased or diminished at pleasure, This arrangement contemplates merely the action of *thrust* in the posts, and not that of *tension*.

The main thrust braces occupy the relative positions assigned to the main braces in the specification of the brace bridge before cited. The parts of which each brace is composed are clamped together by means of trenails, or screw bolts and blocks, or gluts interwoven between the parts, in such a manner as to keep them all in their appropriate relative positions. The number of brace-pieces in each panel of the truss-frame, is the same as the number of string-pieces in each of the strings, instead of being the same as the number of spaces between the string-pieces; and instead of abutting against the posts, they abut against the string-pieces or brace bolsters; moreover, instead of being closely connected to the posts, by means of tuscums and shoulders, their extremities are rendered movable along the strings, by means of bolsters or gluts, and keys or wedges, whereby the trussing of the bridge is effected in a manner different from any method heretofore adopted for this purpose. The main thrust braces may be inserted in, or withdrawn from, the truss frame at pleasure.

Note I. Instead of the relative positions assigned, as above, to the main thrust braces, it is sometimes expedient to introduce these parts in a manner to extend diagonally through two or more panels, and to subserve the purpose of side arch braces, as well as those of main braces. The arrangement here contemplated, is such that two sets of braces may rise from the lower string, at and near the second post of the span, counting from the abutment or pier: one set extending through the second panel, and the other through the second and third panels from the abutment or pier; also, that two other sets may run in like manner, at and near the foot of the third post: one set extending through the third and fourth, and the other through the third, fourth, and fifth panels, from the abutment or pier. This arrangement is duly represented in the accompanying drawings. (See Pl. II., vol. ii, 3rd series, page 176.)

NOTE II. It is sometimes advisable to fortify the truss frames by inserting *extra braces,* especially in the first and second panels from the abutment or pier, in connexion with the main suspensor braces and the posts. The extra braces rise from the lower string about midway of the abutment or pier panel, or immediately back of the suspensor braces at their points of connexion with the lower string, cross the suspensor braces and the posts obliquely, and terminate at the lower side or edge of the string; the extremities of the extra braces abutting against the upper and lower strings. The extra braces may comprise the same number of parts as the main thrust braces, and may be confined in their places by means of trenails passing through them and the posts and suspensor braces, at the points of intersection of the latter, by the extra braces.

The brace bolsters are situated at the extremities of the main thrust braces, occupying a position between these extremities and two alternate angles of each panel of the truss frame, and serving as recipients of the thrust or action communicated by the main thrust braces. The length of the bolsters is at least equal to the horizontal thickness of each string. Their transverse section is in the form of a trapezoid, with two right angles at its back, and one oblique side opposite to the back. The base of the bolster is applied to the string, and its back to the post. The obliquity of the sloped side, is such as to form a right angle, or nearly a right angle, to the direction of the main thrust brace. On the back of each bolster, or the side applied to the post, recesses are formed in the bolster, adapted to the reception of keys or wedges, which are inserted between the edges of the post and bolster as a means of forcing the latter together with the end of the brace to slide along the string in a manner to subserve the trussing of the frame, and of imparting to it the requisite camber stiffness.

Instead of bolsters as just described, it may sometimes be advisable to use *brace gluts* as a means of trussing or straining the bridge. These are pieces of timber of the same width and thickness as the brace pieces, and two to four or five feet in length. The gluts are inserted between, and at each end of the brace pieces, protruding beyond the ends of the latter, far enough to reach nearly or quite through the string. They are firmly fixed in the braces by means of trenails passing entirely through them and the braces. Each glut is scarfed or sloped at its outer end, in such a manner as to admit a key or wedge between it and the edge of the post, by means of which the trussing and cambering of the truss frame may be effected as before.

The *brace keys,* or wedges, are inserted as before remarked, between the brace bolsters or gluts and the posts, and their adjustments may be such, as to admit of their being driven either upward or downward as circumstances may require. In general it will be found, that such adjustments as will admit of driving the lower keys downward, and the upper keys upward, will prove most convenient. The length of the keys, ordinarily, may vary from two to three feet. Their width must be equal to the thickness of the post or braco timbers;—and their thickness may be about an inch at the point and four inches at the butt. They may be sheathed, on their faces and heads, with sheet iron of any suitable thickness, if deemed proper.

Fig. 1.

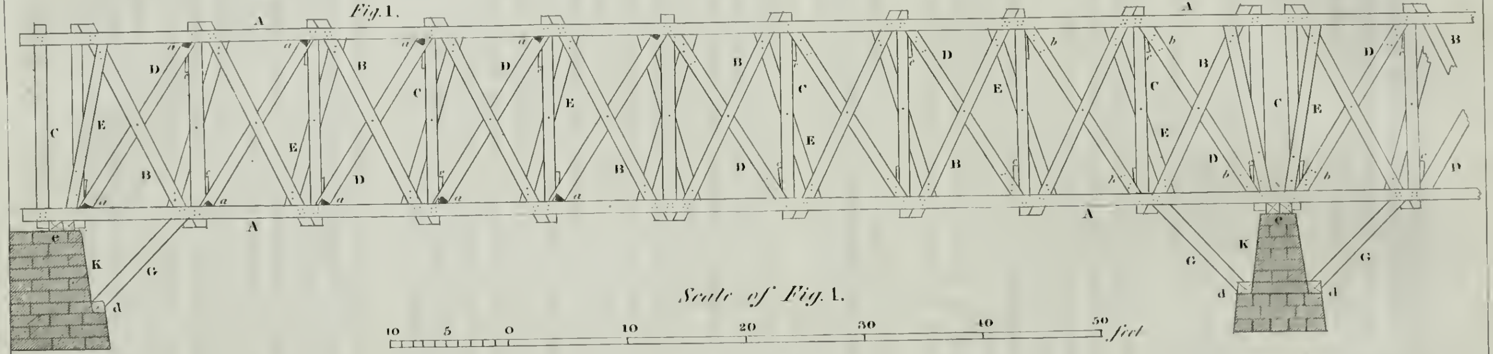


Fig. 7.

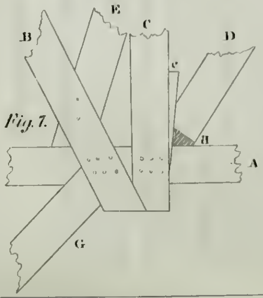


Fig. 2.

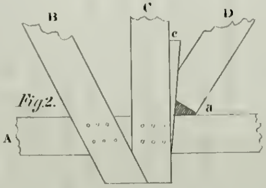


Fig. 4.

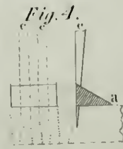


Fig. 5.

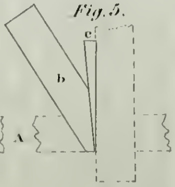


Fig. 3.

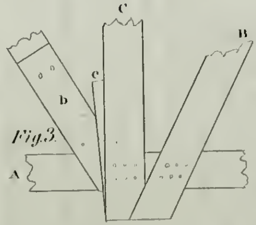
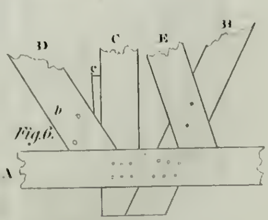
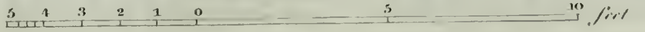


Fig. 6.



Scale of parts



The relations subsisting between the several parts above described, and the manner in which they are connected together, are clearly shown in the accompanying drawings, which together with the explanations thereof, are intended to form part of this specification.

The trenails, screw bolts, screws, &c., should be similar in size, shape, and dimensions, to those described in the patents of 1839, before cited; (see descriptions of brace and suspension bridges, vol. xxv, 2nd series, pages 325 to 331;) moreover the *lateral*, the *transverse*, and the *arch bracings*, of the bridge as also its *floorings*, its *roofings*, &c., &c., may be such as have been described in former patents, granted to Col. Long, or such as have been adopted in other methods of bridge building.

In constructing the composite bridge, it is advisable to keep the lower string as nearly straight as practicable, while to the upper string (both strings being applied and resting on the *framing ways*) it is deemed best to give a rising or crowning *camber* such as would result from a rise of about one inch at each successive post, counting from the abutment or pier, towards the centre of the bridge-span, varying the successive rises in such a manner as to produce a regular curve in the upper string, so that in a bridge span of twelve panels, the distance between the upper and lower strings will be about six inches greater at the centre, than at the extremities of the span. This distance will be increased or diminished in proportion as the span contains a greater or less number of panels than that above mentioned. The *camber* thus given will be somewhat increased when the trussing of the bridge shall have been effected by driving the brace keys intended for this purpose.

In further illustration of the composite bridge, the accompanying drawings, (see plate II,) and the following explanatory references are hereto annexed, and are to be regarded as part and parcel of this specification, to wit:

Fig. 1, Side view of one of the truss frames of the composite bridge, showing the manner of arranging and combining the several parts of which it is composed. N. B. The left half of this figure represents the manner of introducing the brace bolsters; and the right half, the manner of introducing the brace gluts.

Fig. 2, shows the manner of introducing the brace bolsters, together with their keys or wedges, also the manner of connecting the main suspensor braces, the posts, or vertical ties, and the main thrust braces, with the strings.

Fig. 3, Shows the manner of introducing the brace gluts together with their keys or wedges, &c., as in fig. 2.

Fig. 4, A side and end view of the brace bolster and its keys, projected into each other.

Fig 5, A side view of the glut, and its key, in connexion with the post and string.

Fig. 6, Side view of the string, post, main suspensor brace, main thrust brace with its glut and key, extra braces, trenails, &c.

Fig. 7, Same as in fig. 6, except that the brace bolster is substituted for the glut, and an arch brace has been added.

References to, and explanations of, the Parts represented in the Drawings above mentioned.

A A A. The strings of the truss frame composed of two or more pieces, together with the splicings as heretofore patented. (See Pl. IV. fig. 1., vol. xxiv.)

B B B. The main suspensor braces, each consisting of one or more pieces.

C C C. The posts or vertical ties, consisting of the same number of pieces as the main suspensor braces.

D D D. The main thrust braces. The number of pieces in each of these braces, exclusive of the bolsters or gluts, and trenails, may be the same as that of one of the strings.

a a a. The brace bolsters. *b b b.* The brace gluts.

c c c. The brace keys or wedges, *d d d.* The arch brace bolsters.

e e. The bridge bolster.

E E E. The extra braces and their positions with respect to other parts of the truss frame.

G G G. The inferior arch braces.

The places of the trenails, screw bolts, &c., are indicated in the drawings above considered, by small circles or dots. Moreover, the parts referred to in each of the figures, are represented in all cases by the same letter.

Having thus fully described the manner in which I construct my composite bridge,—I hereby declare that the improvements claimed by me as new therein, and which I desire to secure by letters patent, are the following, that is to say:

I claim as new, useful, and original, the method of trussing or straining the truss frames of bridges and other analogous structures, in the manner and by the means set forth, and described in the foregoing specification: that is, by inserting and driving keys or wedges between the posts or vertical ties, which are stationary, and the bolsters or gluts, which are movable; whereby the said bolsters, or the said gluts, together with the ends of the main thrust braces, may be made to slide along the strings, and the requisite trussing or straining is produced and imparted to the truss frames, without changing the relative positions of the strings, posts, or main suspensor braces.

I also claim as new, useful, and original, the application and use of the extra, or auxiliary braces, in connexion with the posts and main suspensor braces, and abutting against the string pieces, in the manner set forth and described in the said specification, for the purpose of strengthening, stiffening, and otherwise fortifying the truss frames of bridges.

The several arrangements and combinations of parts and principles contemplated in the foregoing specification and claims, together with the various actions and operations therein considered, are to be regarded as distinguishing features, or characteristics, of my composite bridge, as compared with those of all other bridges.

STEPHEN H. LONG.

(To be Continued.)

Account of the Experiments to determine the Principal Laws and Numerical Data, which enter into the Calculation of Steam Engines, by M. V. Regnault.

(Continued from page 141.)

FIRST MEMOIR.

ON THE DILATATION OF ELASTIC FLUIDS.

Part 1.—*Dilatation of Atmospheric Air, under the ordinary Pressure of the Atmosphere.*

M. Regnault commences his memoir, by remarking that there is, in physical science, no numerical element which has been submitted to a greater number of experimental determinations than the co-efficient of dilatation of atmospheric air, and that nevertheless we cannot yet say that this co-efficient is known to us with sufficient precision. The experiments of the elder physical philosophers, gave numbers so different from each other that no use can be made of them. The greater part of the circumstances which influenced the phenomenon were unknown to them.

The experiments of M. Gay Lussac, (Annales de Chimie, 1st Series, tom. xliii, p. 137. Biot. Traitè de Physique, tom. i, p. 182,) seemed to have settled the question finally. He showed by a great number of experiments that between 0° and 100° (32° to 212° Fahr.) the co-efficient of dilatation was the same for all gases, and for vapors, when they were at some distance from their point of condensation, and that its value was 0·375.*

This co-efficient was adopted by all physical philosophers, and employed in calculations, until in these latter years a Swedish philosopher, M. Rudberg, cast a doubt upon its exactness. By a series of experiments made with care, M. Rudberg endeavored to show that the co-efficient of M. Gay Lussac was much too large, and that its true value was comprehended between 0·364 and 0·365.

The experiments of M. Rudberg are then described at length, by M. Regnault. These experiments were originally published in two memoirs contained in Poggendorff's Annals, vols. xli and xliv, and the English reader will find them in the valuable Scientific Memoirs, edited by Richard Taylor, vol. i, pages 507 and 514.

Rudberg terminates his second memoir by an important remark, which had already been made in 1803, by Gilbert, (Gilbert's Annals, vol. xiv, page 267,) but had been entirely forgotten, viz: that the experiments of Messrs. Dalton and Gay Lussac, which had been regarded as having given almost identical results, differed, on the contrary, very much. In fact, in the memoir of Dalton, (Memoirs Soc. Manchester, 1st Ser., Vol. v, Part 2, p. 598,) he says:

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* The results arrived at by Mr. Dalton, about the same time, (Memoirs Lit. and Phil. Soc. of Manchester, 1st Ser., Vol. v, Part 2, p. 598,) appeared to give a co-efficient, identical, or nearly so, with that of Gay Lussac, (0·3726,) and confirmed his assertion as to the equal dilatation of different gases, so that Mr. Dalton himself adopted the co-efficient found by M. Gay Lussac.

"I have repeatedly found that 1000 parts of common air, of the temperature 55°, and common pressure, expand to 1321 parts of the thermometer; to which, adding 4 parts for the corresponding expansion of glass, we have 325 parts increase, upon 1000 from 55° to 212°, or for 157 of the thermometer scale *(Fahrenheit)*." It is evident that the volume of air here assumed as the unit, is that of air at 55° Fahr., or 12·78 cent. If, on the contrary, we take for unit the volume of air at 0° (32° Fahr.), and put the dilatation between 0° and 100° $=100\alpha$, the results of Dalton give

$$1+12{\cdot}78\alpha : 1+100\alpha :: 1000 : 1325; \text{ whence } 100\alpha = 0{\cdot}392.$$

This, then, is Dalton's true result. In truth, Dalton himself does not appear to have observed the error which had slipped into his calculations, for he says in his new system of chemical philosophy:—"The volume of air, according to the experiments of M. Gay Lussac and Minè, being 1000 at 32° Fahr., becomes 1376 at 212° Fahr.

In a note M. Regnault notices a series of experiments upon the same subject, made about the same time with his own, by Prof. Magnus of Berlin. An extract from Prof. Magnus' memoir will be found in the Annales de Chimie et de Physique, 3d Ser. tom. iv, page 330; and a second memoir upon the same subject, tom. vi, p. 353.

M. Regnault then proceeds to give his own method of experimenting, and the details of his experiments.

These methods were five in number. In the first four, the dilatation of the air was deduced from the observed changes in its elastic force at the temperatures of 0° and 100° cent., assuming as true the law of Mariotte, that the elastic force of a gas varies inversely as its volume, when the temperature remains the same. The fifth method was an attempt to measure directly the augmentation of volume due to the change of temperature.

The first method was similar to that used by Rudberg, in his first series of experiments, and by Dulong and Petit, in their comparison of mercurial and air thermometers.

The apparatus consisted of a glass cylindrical reservoir, from 25 to 30 millimetres in diameter, and about 110 millimetres long, containing from 800 to 1000 grammes of mercury. To this was soldered a capillary stem, of which the diameter varied in the different experiments, from ½ to 2 millimetres. This was bent at right angles, at some distance above the reservoir, and drawn out to a fine point. The reservoir and the greater part of the stem were immersed in a vessel of water boiling under the usual atmospheric pressure, and filled with perfectly dry air, by exhausting it from 25 to 30 times, by means of a small pump, and re-filling it each time with air which had passed through two tubes, each one metre in length, filled with pumice stone, saturated with concentrated sulphuric acid. This being done, the apparatus was suffered to stand from half an hour to an hour, the water being maintained in full ebullition, the end of the capillary stem was then closed by the blow-pipe, and the height of the barometer noted. The reservoir, with its stem, was then inverted upon a stand, so that the point of the stem dipped to some distance in a cup of mercury, the point was broken off under the mercury, and the reservoir surrounded with pounded ice, and left in this condition for an hour or more, until the whole of the air (now contracted so as to fill only a portion of the reservoir) was reduced to the temperature 0°. The end of the stem was then again closed by a little wax, the barometer again noted, the position of the surface of the mercury in the cup marked by a point adjusted by a screw—the cup removed, and the reservoir and its contents suffered to take the temperature of the surrounding air. The height of the mercurial column above the level of the mercury in the cup, was then measured by the cathetometer. The reservoir and its contents were then weighed, entirely filled with mercury, first boiled to free it from air and moisture, the point again immersed in mercury, and the reservoir surrounded with ice. At the end of one or two hours, when it was satisfactorily ascertained that the whole apparatus had taken the temperature 0°, the ice was removed, the mercury which was discharged by the rise of temperature, was received in a capsule, and the apparatus placed in a boiler, as at first, and brought to 100°. The mercury expelled was collected in the capsule, and the height of the barometer at the moment of ebullition noted. By this means, all the data necessary to calculate both the dilatation of the air, and that of the glass vessel which contained it, were given.

In performing these experiments, M. Regnault observed a serious cause of error. When the point of the stem was broken under the mercury, he observed that a small quantity of air leaked into the reservoir, even when the point was plunged to the depth of $\frac{1}{10}$ metre under the mercury. This air was a portion of that which remained in contact with the glass tube, which not being wetted by the mercury, allowed, as it were, a tube of air from the point to the surface. This difficulty was obviated by attaching to the glass stem, plates of well cleaned brass, to which the mercury adhered, and thus the entrance of the air was prevented. In addition to this, a layer of sulphuric acid was sometimes poured upon the surface of the mercury, before the point was broken, and was carefully removed before the point was again closed. Equal care was taken to prevent the air enfilming the pincers used to break the point, from getting access to the interior. In this method fourteen experiments were tried, the mean of which gives for the volume of 1000 measures of air, at the temperature of 0°, when heated to 100°, 1·36623.

The highest number obtained in any experiment, was 1·36689
The lowest " " " " " 1·36549

The difference is 0·00140

or about $\frac{1}{976}$ of the mean.

The lowest number was above the mean result obtained by Rudberg. M. Regnault believes that this may probably be due to the phenomenon of the entrance of the air upon breaking the point having taken place in the experiments of the Swedish Professor, and he remarks that the error would be greater in proportion as the quantity of air operated on was less. He also states that he believes that the first experiments of his own series were affected by this phenomenon, and as an evidence of this states, that from the moment that he succeeded in preventing it entirely, no experiment gave a number below 1·3659.

The second series of experiments was tried with an apparatus differing but little from the one just described. The reservoir was a glass globe of from 350 to 400 cubic centimetres, soldered to a thermometer stem, about 38 centimetres long; upon this thermometer tube was soldered, at the distance of 11 centimetres from the bulb, a piece of tube very regular in its diameter, about 50 millimetres long, and of a diameter sufficiently large to present but feeble capillary action. The thermometer tube was bent at right angles, and drawn out to a point. The first operation was to gauge the apparatus carefully, and to ascertain its co-efficient of dilatation. This was done by filling it with mercury at the temperature 0°, then submitting it to a temperature of 100°, collecting the mercury expelled, and weighing this, and the quantity which remained in the bulb.

The dilatation of the air was then determined very much as before. Eighteen experiments were tried in this way, the mean of all of which was 1·36633; the maximum, 1·36708; minimum, 1·36585; the difference, 0·00123, or $\frac{1}{1111}$ of the mean.

The third series of experiments was performed with an apparatus imitated from that described by Rudberg, in his second memoir. Upon a shelf within a copper alembic, the cover of which is firmly fixed upon an appropriate support, is placed a glass cylindrical reservoir, 35 millimetres in diameter and 170 millimetres long; to its upper extremity is soldered a thermometer tube, which passes through a tubulure in the cover, and bending twice at right angles, is soldered to a larger tube, which dips down into a cistern of mercury, passing air-tight through a tubulure in its cover. On the same shelf is placed a precisely similar reservoir, terminating in a straight thermometer tube, which passes through another tubulure in the cover, and this apparatus being properly filled with mercury, furnishes a delicate thermometer for noting the temperatures in the alembic. The mercurial cistern is furnished, in its lower part, with a piston, movable by a screw. Through a second tubulure in the cover of the cistern, passes a straight gauge tube, open above, and dipping into the mercury below, and of the same diameter as the tube which terminates the thermometer stem. The capacity of this apparatus having been gauged, and the co-efficient of dilatation determined by a previous experiment, the reservoir is filled with dry air, and the alembic filled with ice, so as to reduce the temperature to 0°; the piston in the mercurial cistern is then raised or lowered, until the mercury in the tube communicating with the reservoir, stands exactly at a mark previously made upon it, and the difference between this point and the top of the column of mercury in the gauge tube, is measured. The ice is then removed from the alembic, and replaced by water, which is boiled, and the temperature of the reservoir being thus brought to 100°; the piston is again adjusted, so as to bring the mercury to the same height as before, in the tube communicating with the reservoir, and the differences of its height in this tube and the guage tube again read. These two readings of course give the elastic force of the air at these temperatures, and from these the co-efficient of dilatation deduced. The experiments tried with this apparatus, give a mean 1·36679 — the difference between the minimum, 1·36747, and the maximum, 1·36812, being $\frac{1}{10125}$ of the mean. M. Regnault does not believe this method susceptible of the same accuracy as the other, on account of the irregular action of capillarity in the tubes, although purposely taken of equal diameters. He also remarks that the results obtained by him are larger than those got by Rudberg, from a somewhat similar apparatus, which he believes may be attributed to the latter having made his mark upon a capillary tube, and to his neglecting the small quantity of air contained in the thermometer tube, which is not heated to 100°. As however, unfortunately, M. Rudberg has not stated the dimensions of his apparatus, it cannot be ascertained what influence this had upon his results.

(To be Continued.)

On Ornamental Art as applied to Ancient and Modern Bookbinding. Read by MR. J. CUNDALL, *before the Society of Arts, London, November* 10, 1847.

The author commenced by stating that the earliest records of bookbinding prove that the art has been practised for nearly 2000 years; previous to which time, books were written on scrolls of parchment. Some inventive genius, however, to whom the Athenians erected a statue, at length found out a means of binding books with glue; the rolls of vellum, &c., were cut into sheets of two and four leaves, and were then stitched somewhat as at the present day. Then came the necessity for a covering. The first book-covers appear to have been made of wood, probably merely plain oaken boards, which were afterwards succeeded by valuable carved oak bindings; these were followed by boards covered with vellum or leather, and specimens of such of great antiquity still exist. The Romans carried the art of bookbinding to considerable perfection, and some of their public officers had books called "Diptycks," in which their acts were written. An old writer says that about the Christian era, the books of the Romans were covered with red, yellow, green, and purple leather, and decorated with silver and gold. In the 13th century some of the gospels, missals, and other service books for the use of the Greek and Roman churches, were covered in gold and silver; some were also enamelled and enriched with precious stones and pearls of great value. In the 15th century, when art was universal, such men as Albert Durer, Raffaelle, and Guillo Romano, decorated books. The use of calf and morocco binding seems to have followed the introduction of printing, and there are many printed books bound in calf with oaken boards about the 15th and beginning of the 16th centuries; these are mostly stamped with gold and blind tools: the earliest of these tools generally represent figures, such as Christ, St. Paul, coats of arms, &c., ccording to the contents of the book. In the reign of Henry VIII., about 1538, Grafton, the printer, undertook to print the Great Bible, for which purpose he went to Paris, there not being sufficient men or types in England; he had not, however, proceeded far when he was stopped in the progress of this "heretical book," upon which he returned to England, bringing with him presses, type, printers, and bookbinders, and finished the work in 1539. Henry VIII. had many books bound in velvet, with gold bosses and ornaments; and in his reign the stamping of tools in gold appears to have been introduced. In the reign of Elizabeth, some exquisite bindings were done by embroidery, the queen herself working the covers with gold and silver thread, spangles, &c. Count Grolier seems to have been a great patron of the art on the continent, and all his books were bound in smooth morocco or calf ornamented with gold. The style of the books of Maioli was very similar to that of Grolier, or those of Diana of Poictiers, the specimens done for her being among the finest ever produced, and were no doubt designed by Petit Bernard. Roger Paine was the first Englishman who produced a really good binding, and some of his best works, such as French romances, were powdered with the fleur-de-lis. His books on chivalry had suitable ornaments; on poetical works he used a simple lyre, and carried the emblematical style of binding as far as emblems ought to be used. The following bill of his for binding a work is a curiosity, and shows how moderately he charged:—

"Vaneria prodium Rusticum, Parisiis, MDCCLXXIV.

"Bound in the very best manner in the finest green morocco, the back lined with red morocco. Fine drawing paper and very neat morocco joints inside. There was a few leaves stained at the foredge, which is washed and cleaned.	0 0 6
"The subject of the book being 'Rusticum,' I have ventured to put the Vine Wreath on it, I hope I have not bound it in too rich a manner for the book. It takes up a great deal of time to do these Vine Wreaths; I guess within time I am certain of measuring and working the different and various small tools required to fill up the Vine Wreath, that it takes very near 3 days' work in finishing the two sides only of the book—but I wished to do my best for the work, and at the same time I cannot expect to charge a full and proper price for the work; and hope that the price will not only be found reasonable but cheap.	0 18 0

Civ. Eng. & Arch. Jour.

Note on the Action of a Solution of Caustic Soda upon a Stoneware Jar, by Mr. Trenham Reeks.

Having been puzzled in the analyses of some bronzes and iron ores, with the presence of an excessive quantity of alumina, I was induced to examine the reagents employed, and found that this excess originated in the soda, which had for some time been standing in an earthenware jar. I send a piece of this jar, which exhibits a thick coating, nearly all composed of silica, the alumina having been dissolved out by the soda. Chem. Soc. Mem.

Experiments on Crystalization under Extreme Pressure. By W. S. WARD.

This was merely a statement that a number of experiments had been made since the last meeting of the Association, with a view of determining if a speculation then thrown out was correct. Common salt, muriate of ammonia and other salts were exposed, in solution, to a pressure of 100 atmospheres; but no difference in their crystalizable powers were apparent. It was therefore proved, that under a pressure equal to that found in the depths of the Mediterranean no crystalization from pressure would take place. London Athenæum.

BIBLIOGRAPHICAL NOTICE.

Report of the Superintendent of the Coast Survey, showing the progress of the work during the year ending October, 1847.

This work, commenced many years ago by our government, and prosecuted since then with greater or less energy, is one which, whether we consider its importance to our commercial interests and means of defence from aggression, or the greatness of the undertaking, and its influence upon our national reputation for science and skill, ought to attract the notice of every one of our citizens. Yet, until the appointment of the present superintendent, the existence of such a survey was scarcely known, and even yet we fear that its great interest and importance have not received the attention which they deserve. We therefore desire to devote a short space of our Journal to call the attention of our readers to this great work, not only on account of its intimate bearing upon the pecuniary interests of the community, but because, from the vastness of the design, and the difficulties of its execution, as well as from the admirable skill with which it has been heretofore conducted, it is an honor to our country, and entitles us to take rank, in our contributions to useful human knowledge, with our sisters of earlier civilization; an object of ambition at least as honorable as that of rivalling them in their military achievements.

The object of the Coast Survey, is to procure an accurate chart of our extended and dangerous sea-coast, in which every prominent object, natural or artificial, visible from a vessel approaching the land, and every change in the depth of the water, the character of the bottom, and the set and force of the ocean currents shall be so clearly and precisely delineated, that the mariner may be enabled easily to recognize his position upon the coast, be fully warned of the dangers which lie in his path, notified of the harbors of safety which lie open to him, and instructed how to enter safely the port of his destination. This is the first and great certain utility of the proposed survey; but when was the exertion of human science and skill useful but in one direction? It enables the proper authorities, in case the flag of a foreign nation shall ever again bring a hostile message to our shores, to foresee the dangers of attack, and to combine a consistent system of defence; and what is far better, the knowledge of this additional element of strength, and the closer knitting of the great bond of friendly communion, by the diminished risk of ocean communications, adds an element of incalculable power to the influences which promote peace. And moreover, conducted as it has been heretofore, with the spirit of broad science and profound investigation, it must add materially to our knowledge of the phenomena of the ocean, and by generalizations from its facts improve the art of navigation, and cause the mariner in the most remote regions of the sea, to feel the beneficial effects of the survey of our coast.

But to insure such important blessings to numbers of our race, is not an easy matter. It is no common map which is to furnish the seaman with a secure guide; and it requires no common resources of knowledge, patience, and energy to overcome the obstacles, and fix with absolute accuracy, the position of each head-land upon our coast, and of every rock and sand-pit which lurks under the waters of the adjacent ocean. It requires no ordinary talents to conduct sucessfully, even a topographical survey upon land, such, for instance, as that which the State of Massachusetts has recently furnished, as a pattern for her sister States hereafter, when they shall see the importance of substituting maps of their territory, for the fancy sketches of imaginary mountains and impossible rivers which now pass under this name; but when there is added the difficulties of accurate hydrography, the determination of the forms and directions of ridges of rock or mud which lie invisible beneath the surface of the sea, it may be easily conceived that a vast expenditure of labor is required, and absolutely inexhaustible resources of knowledge.

To execute such a survey, then, the first thing to be done is to fix with extreme accuracy, a number of convenient points, determining their distances apart, and their relative positions. To do this with the necessary precision, by direct measurement from one point to another, would be impossible, and if possible would require centuries for the completion of the work; recourse must therefore be had to the principles of trigonometry; and a single base-line conveniently selected, and of some length, (say ten miles,) being once accurately measured, and its position in relation to the meridian being carefully determined, the angles of position of any number of points, from the extremities of this base, may be observed, and we shall then have all the data necessary for a calculation by which their relative positions and distances may be found with precision limited only by the correctness of the observations. The distance between any two of these points being thus ascertained, will furnish us with a new base, from which we may proceed, as before, to the determination of new points, and thus the whole tract to be surveyed is covered with a series of triangles, the positions of whose vertices are known. This operation is called the primary triangulation. The length of the sides of these triangles, will of course vary with circumstances, and will principally depend upon the nature of the country. In a mountainous region, they may be from fifty to seventy miles, while in a flat tract it may be impossible to obtain a greater length than twelve or fifteen. The space within these triangles is then, by a second operation, subdivided into other and smaller triangles, and these again are similarly subdivided; and thus the whole tract becomes covered with a net-work of lines well determined both in length and direction, the areas within which are sufficiently small to be considered as planes, and the minute features of the topography may then be put in by the use of the plane-table, which is in principle nothing but a drawing-board and ruler, provided with sights, and so mounted that it may be used upon the field. The outline of the coast being accurately known, the result of the soundings within sight of shore can be easily connected with the land-survey—and the position of shoals, breakers, and islands, out of sight of land, can be determined by the usual observations for fixing their actual position upon the surface of the earth.

The work can be verified at any time and place, by actual measurement of any straight lines whose length can be calculated from the triangulation, and it is truly wonderful to see how near these independent determinations agree, when the operations have extended hundreds of miles from the original point of beginning.

It is easy thus to give a general idea of the theory of a trigonometrical survey—but it is impossible to convey to general readers, an idea of the immense and ever-recurring difficulties which oppose the actual prosecution of such a work, still less of the resources of inventive genius, profound scientific knowledge, acute perception, patience, and energy which are required to overcome them, and bring such a work to a successful issue. The whole result rests upon the accuracy of the primary triangulation, and there is perhaps no problem ever solved by the human intellect, upon which all the resources of physical science are so completely exhausted as upon this, and upon the accompanying astronomical observations, by which the absolute positions of the points of the survey upon the surface of the earth are determined, the geodesic operations checked, and the surveys of one country placed in connection with those of others in other quarters of the globe.

Our Coast Survey was well begun and excellently conducted by the late lamented Mr. Hassler. The present superintendent has introduced into it some new features, to two of which, as we consider them of immense practical importance, we propose briefly to allude.

The first of these was so to arrange the organization of his surveying parties, so as to make the work consist, in the first instance, of a number of independent surveys, which, radiating from distinct centres, should, by gradual production, meet each other, and, uniting, form the one great survey in which the work is to result. Such a method of proceeding applies to the work the most severe test of its accuracy which could be devised, for it requires the measurement of a number of base-lines on various parts of the coast, upon each of which rests appropriate triangulation, at the outer verge of which, are numerous points common to two systems, in the determination of which they must accurately coincide; and as this coincidence can only be ascertained by means of the calculations which are performed in the general office at Washington, all trimming and bending *(tech. cooking)* of observations to meet the purpose is impossible, and if any error exist it must be seen. It requires, therefore, no little confidence on the part of the superintendent, in the work of himself and his assistants, to permit the proposition of so bold a plan, the vast importance of which is however easily seen, since it allows all the important harbors upon our extended coast to enjoy at once the benefits of the survey, and thus prevents immense annual losses of lives and merchandize now jeoparded upon our almost unknown seas, shortens the time necessary for the completion of the entire work, and, as the superintendent has shown, (not only on paper, but in practice,) is productive of great economy in the expenditures. This feature has now, we believe, become the settled policy of the government, and under it the operations of the survey in 1844 embraced nine states; in 1845, thirteen; in 1846, fifteen; and in 1847, eighteen states.

The second improved feature which has been introduced by Mr. Bache into the survey, consists in the publication of the maps containing the results of the survey, as fast as the work is completed. In this way the harbor of New York, the approaches of Philadelphia, and several detached harbors upon Long Island Sound and the Chesapeake have been published, and the maps, upon a convenient scale, exposed for sale at a price so low as to allow every one to possess himself of a copy. The vast importance of this feature is two fold. In the first place, as in the former case, it prevents the great loss of property which is every year taking place, and does not require the master of a vessel trading to Boston or New York to wait for an authentic chart, until every sandy rock and brackish lagoon upon the shores of New Jersey and Texas have been surveyed—and in the second place, by shewing the public the results of the survey, it keeps alive their interest in the work, and disposes them favorably towards the undertaking. In reference to the amount of saving of property which is daily accruing from the publication of the results of the survey, let our readers consult the reports and their appendices, for the opinions of our merchants and insurance offices.

The want of space compels us to close this hasty notice for the present, but we propose in a future number to return to the subject, and give to our readers some extracts from the reports to illustrate our remarks, and demonstrate our fundamental proposition, that both from the magnitude and importance of the undertaking, and the admirable manner in which it is conducted, the United States Coast Survey will prove honorable to us as a nation, and useful to mankind at large.

Let us hope then that the suggestion of Mr. Bache, at the close of his last report, will not only be adopted but extended, and that our government will not only order the Pacific Coast to be similarly surveyed, but that it will extend the plan so as to include the lakes and great rivers, and finally, to embrace a complete topographical survey of our whole territory. F.

FRANKLIN INSTITUTE.

Monthly Meeting, February 17, 1848. Dr. R. M. Patterson, *Presiding.*

The following donations were announced:—

From Prof. A. D. Bache, Washington, D. C.—
  Congressional document, containing the Report of the Superintendent of the Coast Survey, showing the progress of the work.—1847.
From the Central Railroad and Banking Company, of Georgia—
  Thirteenth Report of the President and Engineer, and the proceedings of the meeting of the Stockholders, December, 1847.
From the Mine Hill and Schuylkill Haven Railroad Company—
  Their Annual Report for 1847.
From the Pennsylvania Institution for the Deaf and Dumb—
  Their Annual Report for 1847.
From the Academy of Natural Sciences, Philadelphia—
  The Bulletin of their proceedings, Vol. 3, No. 12.
From Mr. J. S. Lippincott, Philadelphia—
  A work entitled, the Mineral Region of Lake Superior, comprising its early history, &c. By J. Houghton, Jr., 1846.
From Messrs. Lea & Blanchard, Philadelphia—
  A work entitled, Principles of Physics and Meteorology. By J. Muller—American edition, 1848.
From Dr. A. M. Comstock, Philadelphia—
  A copy of the New Testament, printed in his Phonetic characters, 1848.
From Solomon W. Roberts, Esq., Harrisburg, Pennsylvania—
  Legislative Documents and the Daily Legislative Record.
From T. H. Forsyth, Esq., Harrisburg, Pennsylvania—
  Legislative Documents and the Bills of the Senate and House of Representatives.
From Prof. R. S. McCulloh, Philadelphia—
  A Congressional Document, containing the report of Scientific investigations relative to the Chemical nature of saccharine substances, and the art of manufacturing Sugar; made under the directions of Professor A. D. Bache, by Prof. R. S. McCulloh, 1847.

The committee on Mr. Elliot Cresson's proposition to found a gold medal, reported recommending the following resolution, which was adopted:

Resolved, That the Committee on Exhibitions be authorized to carry out the intention of Elliot Cresson, Esq., in regard to the gold medal established by him, and to receive from the Trustees designated by him, such directions for the preparations of the dies, and the striking and award of the medal, as the trust created may require.

Eight candidates for membership were proposed.

The following candidates, proposed at the last meeting, were elected members:

Alex. Burbeck, Jr.; Wm. Haywood Drayton; Harris S. Louderback; William Swain; Franklin Stewart; David S. Siner; Robert Warnock; Henry H. Wilson; Joseph D. Williamson; Charles C. Watson, Jr.

The following gentlemen were appointed on standing Committees:

Committee on Library—Messrs. J. Allen, F. A. Brégy, W. J. Levering, J. P. Parke, D. Rhoads, W. Roberts, J. D. Sheble, S. D. Steele, A. Wood, and G. J. Zeigler.

Committee on Arts and Manufacturers—J. C. Booth, W. F. Coggins, J. C. Copper, C. M. Ghrisky, W. Harris, A. L. Kennedy, G. L. Thomas, F. A. Trego, W. P. Troth. and I. S. Williams.

Committee on Meetings—C. B. Foster, E. Greble, B. B. Gumpert, W. Hartel, W. R. Johnson, W. E. Morris, F. Peale, J. B. Reynolds, S. W. Roberts, and G W. Smith.

Committee on Cabinet of Models—J. Agnew, H. B. M. Berkinbine, B. M. Feltwell, H. Huber, Jr., W. H. Loper, J. V. Merrick, T. S. Stewart, T. U. Walter, G. Weigand, and T. F. Williams.

Committee on Exhibitions—J. E. Addicks, J. Agnew, J. C. Cresson, J. P. Ellis, O. Evans, T. Fletcher, B. Huckel, S. W. Roberts, C. A. Walborn, and J. Weigand.

Committee on Cabinet of Minerals—C. F. Beck, J. C. Booth, M. H. Boyé, J. F. Frazer, E. Greble, R. E. Griffith. W. Pettit, R. C. Taylor, A. W. Thompson, and C. B. Trego.

Committee on Meteorology—M. T. W. Chandler, J. P. Ellis, G. Emerson, O. Evans, R. Frazer, B. Huckel, J. S. Lippincott, R. P. Thomas, C. B. Trego, and F. A. Trego.

Communications on subjects connected with science and the arts being called for,

Mr. G. W. Smith called the attention of the members to specimens of various articles made of gutta percha, especially to a driving belt which had been for some time in use in the machine shop of M. W. Baldwin; he asked especial attention to the neatness and strength of the joint made by simple superposition of the two ends of the belt, with pressure, when heated to the temperature of 180°. He also exhibited some specimens of sheets of the substance intended for use in book binding for which it possesses certain advantages; these sheets were beautifully figured in imitation of watered silks, &c. He also noticed the application of the substance to the soles of shoes, and stated that it possessed great durability, and the impermeability to water which distinguishes caoutchouc, and has the additional advantage of not becoming slippery upon wet pavements. Shoes prepared with this material can be procured at the store of Mr. Thornley, in Chesnut street above Fourth.

Mr. G. W. Smith also submitted to the meeting, a model of a new coupling joint for steam (and other) pipes—patented by Messrs West & Thomson. The ends of the pipes to be joined are provided with beveled flanges, between which the patentees prefer to place a piece of prepared caoutchouc or other elastic substance, although this is not absolutely necessary. The flanges are surrounded by a grooved ring, cast in three pieces, and joined by screws, passing from one segment to the other; as these screws are tightened the flanges are compressed. and the joint thus made perfectly steam tight.

Mr. C. B. Foster, Dentist, removed three teeth from the mouth of a gentleman while under the influence of chloroform; upon his recovery from its effects, the gentleman stated that he had felt no pain during the operation.

Dr. Comstock then addressed the meeting, and explained the principles of the formation of his phonetic alphabet, which differed from ordinary alphabets in having a symbol for every distinct sound, of which there are thirty-eight in the English language, while there are but twenty-six letters to represent them. Dr. C. proceeded to enumerate these sounds, and stated that wherever the alphabet of any language had a symbol appropriated exclusively to express any particular definite sound, that symbol had been adopted by him; whereever this was not the case, a symbol had been invented for that sound. When the sound could be considered as a compound, the symbol was so arranged as to present those of the elementary sounds which enter into its composition. Dr. C. explained the advantages which he conceived his system to possess over the ordinary methods of writing the English language.

Mr. Pantoleon expressed his concurrence in the opinions expressed by Dr. Comstock, and proceeded to illustrate the applicability of the phonetic system to languages other than the English. He stated that there were fifty-four distinct simple sounds possible, of which twelve were not used in any language. There were therefore but few additional symbols necessary to be introduced in order to extend the system devised by Dr. Comstock to the expression of every other language. He illustrated his positions by examples from the Turkish languages, and urged the importance of its adoption by Americans as a means of rendering their language easier of acquisition both by children and foreigners.

Mr. Dyer, of New York, was then introduced to the meeting, and proceeded to unfold the principles of the art of Phonography, or writing according to sound. He explained what is meant by writing by sound. The word *awe*, he said is composed of *one simple vowel sound*, as any person would readily perceive upon enunciating it with distinctness. The word *ought* is composed of *two* sounds; *sought*, of *three* sounds, as will also be readily perceived. In short, *all the words in the English language* are formed by combining variously, about *forty simple sounds.* Now Phonography furnishes a sign or letter for every one of those sounds, and no sign represents more than one sound; the ground-principle of the art being *one sign* for a *sound*, and but *one sound* to a *sign.*

Again, the Phonographic letters are the simplest geometrical lines and curves, thus rendering the system as brief as possible. Owing to the certainty of the representation, Phonography can be learned in a very short space of time—twelve lessons of one hour each being sufficient to enable any person of ordinary abilities to acquire a thorough knowledge of the art. Mr. Dyer here instituted several comparisons between the Phonographic and the common mode of writing, which showed the former to be about eight times as brief as the latter. He also introduced some very striking and amusing illustrations of the anomalous character of our common mode of spelling.

To show the legibility of the system, he wrote, in the Phonographic characters upon the black board, a sentence handed in by one of the audience, which was read with perfect facility by a gentleman present familiar with the system, and as proof of its applicability to reporting, Mr. Smith read the following note received by Mr. Dyer, from Dr. J. P. Nichol of Glasgow (Scotland) University, whose lectures on Astronomy Mr. D. recently reported for the *New York Tribune.*

New York, 11, *University Place.*

Dr. Nichol begs to express his approval, and even surprise, at the extreme accuracy of the reports of his lectures which have appeared in the *Tribune.* He has formerly, in Europe, had frequent reason to be gratified with excellent reports; but his previous experience furnishes no instance of a verbal accuracy as perfect, even with regard to portions of his lectures never committed to writing, and often delivered with much rapidity.

The very large space devoted by the *Tribune*, to these reports, has of course rendered that possible, which in other cases could not be accomplished, but still—even making such allowance—Dr. Nichol finds ample occasion to form a judgment of the high value of Phonography, and the skill with which it has been applied.

To Mr. Dyer, *Tribune Office.*

Mr. D. concluded his remarks with a statement of the advantages that would accrue from the introduction of Phonography into general use, and especially into our common schools and seminaries of learning, as a regular branch of education. He dwelt at some length upon the great utility of instructing the youth of the land in Phonography at an early age, so that when they left school at the age of fourteen or sixteen years, they would be able to record with unerring accuracy the words of the most rapid speaker, and treasure up for future reference the glowing thoughts of the impassioned orator.

The system used by Mr. D. is that proposed by Mr. Pitman of England, and differs from that of Dr. Comstock, by the simplicity of the forms of the characters, which are intended for rapid writing, while it agrees with his, in the fundamental principle of having a symbol for the exclusive expression of each distinct sound.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA,

FOR THE

PROMOTION OF THE MECHANIC ARTS.

APRIL, 1848.

CIVIL ENGINEERING.

Annual Report of the Board of Canal Commissioners, with Accompanying Documents, for the year ending November 30, 1847.

The Canal Commissioners of Pennsylvania in making their report of the operations on the canals and railroads of this commonwealth, for the fiscal year commencing December 1, 1846, and ending November 30, 1847, would remark that the receipts up to the first of October, were unprecedentedly great, and the expenses as low as in any preceding year; but on the 7th and 8th of that month a most disastrous flood swept over much of the main line and Susquehanna and West Branch divisions, interrupting the through navigation between Philadelphia and Pittsburg to the close of the year, and suspending that of the Susquehanna and West Branch divisions for a portion of the balance of the season. Notwithstanding the diminution in the revenue from this cause, the receipts and expenditures for the year present the following gratifying result:—

RECEIPTS.

From the Philadelphia and Columbia railroad,	$ 574,988·27
" Allegheny Portage railroad,	230,660·88
" Main line of the Canal,	425,396·78
Total gross receipts on the Main line,	1,231,045·93
From which deduct drawbacks,	7,500·95
Carried forward,	1,223,544·98

Brought forward,		$ 1,223,544·98
From the Delaware Division,		172,191·15
" Susquehanna, and North and West Branches, deducting drawbacks,		185,839·74
Total gross receipts on all the lines,		$ 1,581,575·87

EXPENDITURES.

On the Philadelphia and Columbia railroad,		$ 255,241·00
" Allegheny Portage railroad,		168,253·40
" Main line of canal—*Ordinary expenses,*	114,431·88	
Damages from floods,	50,035·61	
Clark's Ferry bridge,	14,832·93	
		179,300·42
" Delaware Division,		24,108·48
" Susquehanna, and North and West Branches—		
Ordinary expenses,	50,668·53	
Damages from floods,	10·904·00	
		61,572·53
Total expenditures,		688,475·83

Total gross receipts,	$ 1,581,575·87
Expenditures,	688,475 83
Excess of receipts over expenditures,	$ 893,100·04

If the pay of the Canal Commissioners, Secretary, clerk hire, messenger and incidental expenses of their office, amounting to $ 5055·64, be deducted from the above sum, it will leave $ 888,044·40, as the net revenue from the canals and railroads of the Commonwealth for the year ending November 30, 1847; being an increase of $ 307,522·27, over the net revenue of the previous year. Judging from the receipts up to the 1st of October, it is confidently believed that had there been no interruption from floods, the revenue from tolls would have reached $ 1,900,000. The expenditures, which amounted to $ 688,475·83, would, by deducting $ 60,939·61, the cost of the repairs of damage by floods, have been reduced to $ 627,536·22—leaving the net revenue at $ 1,272,463·78, instead of $ 888,044·40.

It will be seen from the foregoing statement that the expenditures for the year, have been swelled by the repairs of the damages caused by the floods. The augmentation of motive power to meet the increase of tonnage on the Philadelphia and Columbia, and Allegheny Portage railroads, has also increased that item of expenditure beyond the amount required for the preceding year.

In making up their statement of receipts and expenditures, the Board have been governed by the actual amount of tolls received, during the year, and the entire cost of motive power, repairs, expenses of collection, &c., whether paid or unpaid. This will account for any apparent discrepancy which may appear between this report, and those emanating from the accounting departments, which are made up from settlements to the close of the fiscal year.

The ordinary repairs of the several lines of canal and railroad have been executed with as much economy as was found consistent with an increasing business, and were confined within the estimate presented in the last annual report of the Board.

The accompanying statements exhibit a large increase in the tonnage transported, as well as the several articles embraced in that increase. They likewise exhibit a steadily increasing trade upon the works of the commonwealth, independent of any sudden and temporary demand for the productions of this or of neighboring states.

On the articles of coal, iron, flour, and grain, the tolls collected at the several offices during the year, were as follow: *

Coal, - - - -	$ 218,970·27
Iron, - - - -	96,582·08
Flour and grain, - - -	133,596·27 †

A detailed statement of the operations on the several lines, is deemed unnecessary, a condensed view being all that is required, either for the information of the public or the action of the Legislature.

The accompanying report of the superintendent of the Philadelphia and Columbia railroad gives a detailed statement of the business of the road for the past year. The expenses exceed the estimates presented to the last Legislature. But this increase of expense bears no more than its just proportion to the increased business of the road. During the winter and spring months a much larger amount of tonnage was transported over it than for any corresponding period of previous years. The tonnage conveyed over the road in 1847 was two hundred and thirty-four thousand two hundred and twenty-nine tons, being an excess of ninety-four thousand six hundred and ninety-nine tons over 1846. This large increase of transportation necessarily increased the expenses of the motive power and repair departments. But notwithstanding this increased expenditure, the net revenue derived from the road is three hundred and twelve thousand four hundred and nine dollars and twenty cents, being an increase over the net revenue of 1846, of sixty-three thousand three hundred and seventy-nine dollars and eighty-seven cents. Nearly the full capacity of the present motive power was called into requisition during the early part of the season. Two new locomotive engines, contracted for in 1846, were placed upon the road in the spring. There are now thirty-seven locomotives in good running order. Two others are under repairs, which will be completed during the winter. The whole motive power of the road will thus be in order for the spring business. If there should be any considerable increase in transportation over the past year, it may become necessary to place at least two new engines on the road the present season.

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* The names of the offices are omitted—the totals only are given. Com. Pub.

† No return for flour and grain from office at Johnstown. The maximum rates of toll render it impossible to ascertain with correctness, the amount of toll paid on these two articles shipped eastward at Johnstown and Columbia. It is estimated that at least fifty thousand dollars should be added to the above statement of toll received on flour and grain at those offices.

The trucks for the conveyance of section boats which were originally put on the road, have been found to be generally inadequate in strength to sustain the weight which they are required to transport. The consequence has been, that they have required frequent and heavy repairs, and are often out of order. The superintendent reports, that "of the fourteen sets with which the business of the spring was commenced, only three (those last built at Columbia) are in a condition for service next season. All those which came from the Portage railroad will require thorough repairing, and those bought from the Reliance line will require eight new trucks and three new cradles entire, besides other extensive repairs. One set has been entirely destroyed." Directions have been given to have the required repairs made to these trucks, so that they shall be ready for transportation before the opening of navigation.

The cost of repairs for the year has exceeded the estimate only two thousand and ninety-five dollars and forty-five cents. About sixty tons of new rails, eleven thousand cast iron chairs, twenty thousand feet of mud sills and string pieces, and ten thousand one hundred cross ties, have been put into the road during the season. Valley Creek and Coatesville viaducts have received extensive repairs. These structures are now in a safe and substantial condition. Repairs were likewise made to the other viaducts, and to the small bridges, water stations, &c. About one hundred tons of new rails will be required for the present year. The largest portion of this iron will be required on two short sections of the road—the first extending from Vine and Broad streets to the Schuylkill viaduct, which is now scarcely passable, owing to the large accession of tonnage from the Reading railroad, and to the number of sidings connecting it with quarries, warehouses, &c.: the second extending from the head of the inclined plane to White Hall, on which there is but a single track. In reference to this last mentioned section, the superintendent observes, that "the propriety of relaying the north track from White Hall to the inclined plane, has been so often pressed upon the attention of the Board and the Legislature, that it is deemed unnecessary to dwell upon the subject in this report. All the arguments hitherto used in its favor are still applicable. The expense, detention, and annoyances, caused by the necessity of stopping the trains at White Hall, have been felt in a greater degree the past year than formerly, on account of the increased amount of business; and it is earnestly desired that measures will be adopted to remedy the evil." The single track from White Hall to the head of the inclined plane is not sufficient to pass with facility the present amount of tonnage conveyed over the road. It is manifest that, upon the completion of the Pennsylvania railroad, from Harrisburg to Pittsburg, a large additional amount of trade will be thrown upon the Philadelphia and Columbia railroad. To meet that accession of business, it will be necessary to relay the north track between the points just indicated, or to avoid the inclined plane. As a measure of economy, leaving out of view the greatly increased facilities which it would give to transportation, the Board are convinced that the adoption of the last mentioned alternative is the true policy of the

Commonwealth. The arguments in favor of avoiding the plane have been so frequently presented to the Legislature, as to render their repetition unnecessary. The south track cannot pass the tonnage with the requisite facility. The north track must, therefore, be relaid, if the present line from White Hall to Philadelphia be preserved. By avoiding the plane, the expense of relaying this portion of the road, together with that annually incurred in keeping up and superintending the machinery of the plane, will be saved. The Board have, therefore, deemed it their duty again to call the attention of the Legislature to the subject, trusting that that body will give it that consideration which is demanded by its immediate connexion with the prosperity of the main line of State improvements.

The Allegheny Portage railroad was opened for transportation on the 11th of March, and was closed on the 26th of November. Much damage was done to the road by the flood of the 7th of October. Two stone viaducts of forty feet span each, over the Conemaugh, were greatly injured; the boat-slip at Hollidaysburg filled up; the track at the foot of the planes, Nos. 7 and 8, carried away, and the road at several other points materially damaged. Temporary viaducts were constructed, and the road repaired, causing a suspension of business for only one week. The estimated cost of the damage to the road by the flood is fourteen thousand dollars.

The motive power was found inadequate to the demands of an increased trade. Although two engines had been transferred from the Philadelphia and Columbia railroad; yet the worn out condition of several of those previously on the road, compelled the superintendent to resort to the assistance of horse power at a period when the price of provisions and labor was on the advance. This has necessarily added to his expenditures. The Board believe that it would be economy to place three new engines on the road, so as to supersede as far as practicable the use of horse power. The increase in the tonnage transported on the road over that of 1846, is fifty-five millions nine hundred and forty thousand and eight hundred pounds.

The nett receipts from tolls, from all sources, is sixty-two thousand four hundred and seven dollars and forty-eight cents. It is, however, proper to remark that this amount does not show the actual profits of the road. A large amount of tonnage, paying a maximum rate of toll, is shipped both from the eastern and western termination of the main line. This toll, which includes the railroad toll, is paid at the offices where the articles are first shipped, and is consequently not carried to the credit of the Allegheny Portage railroad. A comparison of the receipts and the expenditures does not, therefore, show the full amount of profit derived from this portion of the public works.

In the truck department, considerable difficulty was experienced during the first part of the season, from the limited number of sets of trucks for the conveyance of section boats. As a large number of these boats had been built, and were actively engaged in transportation, it was deemed a simple act of justice to those who had embarked in the trade on the implied pledge of the State to furnish them with the means of crossing the Portage, to give them the same facilities as were enjoyed by those using a different mode of conveying goods. Five new sets were, therefore, procured and put on the road during the season. Two sets have been nearly completed at the depot at Johnstown. These will increase the number from seventeen to twenty-four; and as they will all be in good order for the spring business, they are deemed sufficient to meet the demands of section boats for the ensuing year, without producing any unnecessary delay.

The attention of the Legislature has been called, in previous reports of the Board, to the condition of the tracks upon the inclined planes. The superintendent, in his accompanying report, again urges the importance of relaying some of these tracks with heavy T rail. The proposed repair cannot be delayed beyond the period when the Pennsylvania railroad company shall form a connexion between their road and the Portage. The decay of the wooden superstructure, and the worn out flat rails will render it impossible to do the business consequent upon the increased tonnage which may reasonably be expected to be thrown upon the road after the completion of the connexion, with that despatch so necessary to maintain the credit of our important line of improvements. A communication has been received from the company, stating their intention to form the connexion, and suggesting the necessity of placing the planes in proper order.

The Board merely desire at present to call the attention of the Legislature to the subject, leaving it to that body to determine the propriety of the repair and the period of its commencement.

(To be Continued.)

Extract from Lectures on Geology, by Professor ANSTED. *Delivered at King's College, London. On the Application of Geology to Engineering and Architecture, and the Supply of Water to Towns and Cities.*

The Professor treated of the supply of water as an engineering subject, apart from the supply obtained from land-springs, or small artesian wells, considered hitherto on a comparatively small scale, and rather with relation to agricultural purposes than engineering. The subject of drainage and water supply was, perhaps, connected as much with architecture as engineering; but, when he had discussed its relations to the one, it would scarcely be necessary to touch upon the other.

With respect to the supply of water, the Professor thought he could not do better than give them a short outline of what had been done lately with regard to the large and most important town of Liverpool, which had been noted, for some time, as a place which was badly supplied with water, and had been more remarkable than any other town in England for the prevalence of fevers, the more than average illness of its inhabitants, and the short duration of life in the major part of it. The members of the corporation appeared very anxious to do all in their power to remedy that which was certainly one source of those evils—namely, the deficiency in the supply of water. Accordingly, they resolved to obtain an Act of Parliament, empowering them to adopt some measure, which should give the town a larger quantity of that important element. The town was situated on the new red sandstone, and had hitherto been supplied from wells sunk into that stratum, which consisted of a red sand rock, sometimes very soft, sometimes rather hard, intersected with occasional bands of marl, very much faulted with large and continuous veins, often filled up with clay, and many of them completely impermeable. The new red sandstone rested upon coal measures, and certainly contained a great deal of water, which was absorbed from the immediate surface, or drained into it from the hills in pretty large quantities, of which the actual limits were ascertainable, since they knew how much fell from the clouds, and how much was evaporated; and they could calculate how much was lost by drainage into the rivers. The supply thus obtained was found to be very insufficient for the necessities of the town, and it was supposed that the quantity could not be materially increased from this source. This point, however, had to be decided upon by reference to the structure of the district, and by calculating whether they got all the available water of the district, or only a part, and it turned out that the latter was the fact. The mode in which this water was obtained was by wells, with horizontal galleries at their bottoms, to allow the admission of a large quantity of water, which was then pumped to the surface. The water obtained from the new red sandstone contained oxide of iron and some salts of lime and magnesia, which made it exceedingly hard, and ill adapted economically for many useful purposes connected with the manufactures of that neighborhood, and in all operations in which soap was required. It was very good to drink, but unfit for other domestic purposes. The question was, whether a sufficient supply, even of this water, could be obtained from the district? The proprietors of the wells attempted to show that an increased quantity could not be obtained. It was to their interest that that should be the case, and they very naturally believed that it was so—consequently, they opposed all measures, the object of which was to obtain water from any other source. The corporation gathered all the information that could be obtained locally, and then called upon several scientific men for their opinion; and it is a fact of great interest, as illustrating the present practical position of geology, that it was thought necessary to have the opinion of persons, more noted for their geological knowledge than for simply a practical acquaintance with engineering. Professor Phillips was first invited to give his attention to the subject, but was prevented from doing so by his engagements with the Government. He (Professor Ansted) was then applied to, and after close examination and full consideration, he came to the conclusion that a sufficient supply could not be obtained from the new red sandstone formation, he being of opinion that, though a somewhat larger quantity might be had of the water which fell on the district, yet that would not be nearly enough for the requirements present and prospective of a town like Liverpool. What was next to be done? Then came in that admixture of engineering with geological science, now necessary indeed to every engineer, who wished to do his work satisfactorily, and with the consciousness that, whatever the result, every means had been adopted which the circumstances of the case would allow. The engineers looked about the neighborhood far and near, their object being to discover where the necessary supply was to be found. One scheme, which met with considerable favor at first, was to take the water from the Bala Lake, in North Wales, and convey it to Liverpool, a distance of 60 miles, by closed canals. Great natural obstacles, however, intervened, and it was found that this plan involved an enormous expense, with the chance of incurring still greater outlay in overcoming several of those natural obstacles, which could not be well estimated until the work was attempted. This scheme, after exciting much discussion, was at length abandoned, and the engineers began to look nearer home. After again considering the supply from the wells, and again convincing themselves of its utter inefficiency, they found they must resort to other means, and thus originated the somewhat celebrated Rivington Pike scheme. The Rivington Pike district presented a hilly surface of 17 square miles, admirably adapted by nature for such a project. The plan pursued in this case was to take the district and measure its area of drainage, then to estimate the quantity of water that could be obtained from it, and, finally, to consider how the water might be best accumulated. This was a beautifully scientific problem, perfectly practical indeed; but one which had rarely, if ever before, been tried to the extent now proposed. First of all, they had to see whether the quantity of water would be sufficient; and this was effected by accurately marking the water shed, observing where all the rills and streams could be caught conveniently, and, when caught, considering whether they could be conducted into some sound and sufficient reservoir. The model on the table, which was an accurate representation of the district, would show that all those points were readily attainable. The drainage was regulated by the shape of the country, and it might be seen either by the Ordnance Map, a contour map, or a model. In this case, he was able to exhibit a model, which was the best, but the Ordnance Map was the guide originally used. Having then found the area, the question whether it would yield a sufficient quantity of water to supply the town of Liverpool was next to be decided. This calculation involved a considerable amount of knowledge of geological structure. It was easy to tell how many inches of rain descended from the sky on a certain space and in a given time; and they had only to multiply that by the whole area intended to be drained, and they would have the exact quantity which fell upon the whole. That was simple enough; but they had then to ascertain what was the nature of the surface on which the water alighted; for if it were permeable, as sand, for instance, it was obvious that a large proportion would be absorbed and lost; or, if there were many hollows, the water would lie in them and evaporate. These and other geological considerations, had all to be well considered; but geological science showed that the district, being composed of the bed of hard sandstone, called millstone grit, partially covered over with shaley beds belonging to the coal measures, the whole of it might, for practical purposes, be regarded as impermeable. The sandstone rock, oftentimes very soft, was here very hard, a good deal faulted but not open—so that it would allow almost the whole of the water to run off the surface. The consequence was, that almost all the rain that fell ran into the streams, which a further examination showed might be readily collected into two principal reservoirs on the side of the district nearest to Liverpool, which would be 24 miles distant. The natural valleys, in which it was intended to place these reservoirs, had, no doubt, held water before, as the bottoms were covered with fresh water silt. There were also beds of alluvial clay—an additional indication that a considerable quantity of fresh water had at some period been there. By means of two or three embankments, these lower districts would thus accumulate that water, which the structure of the upper districts allowed to run off. The whole of the rain which falls upon an area of 47 square miles would thus be collected, producing a supply of 20,000,000 gallons per day, sufficient for the town of Liverpool were it twice the size, and also for the supply of a more useful and economical article to the mills, bleach-works, and other works in the neighborhood. Here advantage was taken of the peculiar natural circumstances of the district, to make the *minimum* quantity of surface produce the *maximum* amount of water; but which could never have been accomplished, but for a distinct geological knowledge of the structure of the district. Had it not been for a practical application of geological science, that on a certain description of stone the whole of the water would run off, the selection of the Rivington Pike district would never have been made, and the probability was, that Liverpool would have remained for a much longer period suffering from the want of a sufficiency of so vital a fluid. This was a remarkable instance, in which a knowledge of structure had been applied to superficial objects of this kind.

The Professor dismissed the subject of draining by explaining the nature of the operation of a newly-invented draining pipe (Watson's draining pipe), which was remarkably effective. It was cylindrical, with a great number of longitudinal slits, which were wider inside than outside, and thus counteracted any tendency to clog. These pipes were most useful to insert in beds of clay, and, even after a considerable length of dry weather, might be seen giving out water very plentifully. This efficient draining caused the beds to contract and crack, and, by thus making openings for the water, rendered the draining perfect. To the proper use of these pipes a knowledge of the dip of the beds was indispensable. Civ. Eng. & Arch. Jour.

Extract from the Report of the Superintendent of the Coast Survey, showing the Progress of the Work during the Year ending October, 1847.

Use of the electro-magnetic telegraph for differences of longitude.—The use of the telegraph lines established between Washington and

Jersey City, opposite New York, to obtain differences of longitude, has been continued during the present season, and the attempts to obtain differences of longitude, by this method, between Washington, Philadelphia, and Jersey City, have proved entirely successful. The arrangements explained in my report of last year were found sufficient for the continuation of the work. The superintendent of the national observatory, Lieutenant M. F. Maury, again directed the co-operation of that establishment. The observations at Philadelphia were under the direction of Professor Kendall, and those at New York under the direction of Professor Elias Loomis. The details of observation were arranged, and the connexion of the different parts secured, by assistant Sears C. Walker, of the Coast Survey, who was charged with the operation.

The principle of this method is well understood to consist in transmitting signals at a known or determined time, from one telegraph station to another, where they are noted by a time-keeper, well regulated to the time of the place. The difference in the times of giving and receiving the signals, according to the local time at each station, is their difference of longitude expressed in time.

The signals are given at one of the stations by pressing a key, which causes the closing of the circuit. This closing, it is intended, shall be simultaneous with the ticking of a clock or chronometer at the station. The circuit being closed, if the electrical wave or current takes a sensible time to propagate itself, or to pass from one station to another, the absolute time of the signals reaching the second or receiving station is sensibly different from that of making the signal at the first or giving station. A coil about the poles of a horse-shoe magnet of soft iron, forms part of the circuit through which the electrical effect is transmitted. Under its influence the soft iron becomes magnetic, attracting the soft iron bar (armature or keeper) delicately poised at a determined distance from the poles of the magnet; the movement of this keeper sets in action a local battery which gives sufficient power to make the dots and lines constituting the Morse telegraphic signals. The click of the keeper of this temporary magnet is compared, at the receiving station, with that of a clock or chronometer, thus marking the time at which the signal, made at a known time at the giving station, is received. From this explanation, it appears that there is liability to error: 1, in the clock times at the different stations. These are easily examined and the most probable times assigned at each station, the personal equation for clock correction being determined and allowed for, they may then be treated as if only very small errors existed. 2. The time of striking the trigger or key, to close the circuit, may not coincide with the clock beat. The error, if any, from this source is determinable by experiment; and careful experiment failed to detect a sensible amount. 3. The electrical effect may take a sensible time to be transmitted, and this may be known, if other sources of error could be got rid of, by transmitting signals from an eastern to a western station, and vice versa; and it may be rendered null in its effect upon determinations of differences of longitude by such alternate transmission, or it may be examined in its combined effect with the next error. 4. That of the sensible interval, if any exist, between the activity of the coil, its action in inducing magnetism in the receiving magnet, and the click of the keeper of this magnet. 5. The error in noting the fraction of a second as denoted by the clock. It was perceived that this difference in the estimate of fractions of a second, rendered the transmission of signals, by the beats of a well regulated sidereal clock, and their reception by another sidereal clock, of little avail, the time falling constantly upon the same fraction of the second. The transmission of signals, by beats of a mean solar chronometer, and the marking of the time of reception by a sidereal clock or chronometer, carries the fraction of the second over every part of the whole second, and once, at least, in ten minutes marks the coincidence of the beats of the two time-keepers. By observations of the coincidences, and the marking of intervals at the same station, the law by which each observer varied in the estimate of fractions of a second became known, and, of course, the differences (or receiving personal equations) of each observer, supposing them to be constant. Pains were taken to compare personal equations by all the observers. It turned out, finally, that this might have been done by transmitting signals; but, then, to have assumed it would have been to anticipate a result which was sought. The part of the error, then, of receiving signals from error of noting time, was ascertained numerically, and its value could be assigned within certain limits in any case. The inference is drawn from an examination of this class of personal equations, " that when the two clocks" (the one by which signals are given, and the other by which they are received, both being rated either to mean solar or to sidereal time) "do not coincide in their beats; the observers, on the average, set down the fraction of a second of the signal received too small." Of the five errors, then, which I have enumerated, the numerical values could be assigned to two, (viz: 1 and 5,) and one (viz: 2) was insensible. After assigning the values in any particular case to 1 and 5, there remain residual errors, caused by 3 and 4. Now, it is plain that both of these will affect the result alike; that is, will tend to make the time of receiving the signal later than it should be by the amount of retardation of the wave or current, and by the difference in the time of its reaching the spiral coil and the click of the keeper of the receiving magnet. But a comparison of the observations shows a very small residual quantity having just the opposite sign, the signal being apparently received *earlier* than it was given. From this, the nullity of both these corrections, 3 and 4, is fairly inferred, and the interesting consequences follow, that " the telegraphic method of comparing clocks, distant two hundred miles from each other, is free from error when the method of coincidence of beats is employed, and that the probable error of the longitude, from this method, is the same as the mean result of the computed relative correction of the clocks for the nights of observation." An investigation of the probable value of such error shows that, under favorable astronomical circumstances, and with due care in the use of the transit instrument, " the astronomical difference of longitude, between any two stations of a trigonometrical survey, may be determined by telegraphic signals, with a degree of precision of the same order as that of the differences of latitude," the inaccuracy depending upon the same causes as the deviation of the plumb-line.

The very interesting and elaborate report of Assistant Walker, of which I have thus given the chief conclusions, will be published with the other results of the year. It contains, in separate sections—1, a discussion of the theory of Morse's telegraph; 2, of the difficulties in the use of the telegraph, from imperfect insulation; 3, the theory of the adjustment of the magnets; 4, the theoretical discussion of the errors of the clocks at the different stations is thoroughly made, and equations of condition are formed for deducing the most probable errors from the observations; 5, equations of condition are formed for giving the most probable difference of longitude from the observations. Under this head, the mode of giving and receiving signals is discussed; the essential character of the method of coincidences is insisted on; tables of personal equations for each observer, and each fraction of the second, are framed. The key-beat and armature-beat in giving signals, are found not to differ. The correction for time of transmission of electrical effect, or "circuit time," and for the armature-beats of the receiving magnet, are explained, and the whole of the physical circumstances are expressed in an algebraic form. 6. The corrections for errors of the clocks at the several stations are deduced and applied. Full tables of the observations at the several stations are given in this connexion. The corrections for the differences in noting time by the different observers, (or personal equations of clock corrections,) are next made. 7. The table of signals transmitted and received is given. 8. The results of this table are examined and compensated by the equations of condition. 9. Numerical values are assigned, from observation, to the quantities independently compared, and the consequences obtained which have been given above.

Measurement of base line.—The site for the base line on Dauphin island was selected by Asssistant F. H. Gerdes, after his general reconnaissance of this part of the coast in 1845; and two preliminary measurements with the chain were made at different times, under his direction, by Messrs. Walker and Greenwell. The site presents great facilities for measurement and connecting the base with the triangulation. It is exposed, as all sites near the ocean must be, to the gradual or sudden action of the water, but, as far as can now be foreseen, is likely to be permanent, so as, if necessary, to afford an opportunity for remeasurement. The base was laid out from near the woods on Dauphin island westward for nearly seven miles to the western extremity of the island, which at that end is increasing. It has been kept as far as practicable from the gulf side of the island. It passes, first, through the firm salt marsh which borders the Mississippi sound, then over the dividing ridge of low sand hills, upon sand flats with scarcely a rise, again upon firm marsh or sand flats covered with short grass on the sound side of the island. All the preparatory arrangements were made under the direction of Mr. Gerdes before my arrival at Dauphin island.

The measurement of the base was made by me, assisted personally by Mr. Gerdes and his party, to which were attached Assistant Julius E. Hilgard and Mr. J. Hewston. The grading, where required, was done under the direction of Mr. W. E. Greenwell. The records were kept by Mr. Samuel Arthur. The apparatus was safely transported from Washington to Dauphin island, under the charge of Mr. Thomas McDonnell, who also aided in the measurement. Mr. Wurdeman accompanied me to make the repairs which it was supposed might be required from time to time, to examine the apparatus, and to see the working of the different parts.

The base apparatus presented some novel features in construction, the adaptation of others not hitherto used in field work, and a choice of parts previously used by others. The general plan was devised by me, and the details by Mr. William Wurdeman, by whom they were executed under my direction.

This is not the place to describe the base apparatus, but I may be allowed briefly to allude to its general features:

1. The measuring bars were upon the compensating system, first used, I believe, by Colonel Colby in Great Britain, and by Mr. Borden in the United States, but the mode of obtaining the compensation differed entirely from that used by either of these gentlemen.

2. A principle was introduced in reference to the dimensions of the bars, which, if at all recognised, has not been hitherto applied, though obvious enough. A bar of brass and a bar of iron of the same dimensions, exposed to the same source of heat, will not heat equally in equal times. This is well known to depend upon the different conducting powers of the two metals, their different specific heats, and the different powers of their surfaces to absorb heat. The bars, then, if of equal sections, when the temperature is rising or falling, have not the same temperature, and the system is not compensating. The surfaces are easily made to absorb equally by the same coating, and the *sections must be so proportioned to each other that the bars will have the same temperature* when exposed to variable temperatures of the atmosphere and of the case containing them. Having arranged the sections approximately, using numbers taken from the books, the changes in length during increase or decrease of temperature were not perceived when microscopes were used supported upon wooden stands, or even upon stone blocks of small size; the means of measurement were not sufficiently delicate to perceive them, or they were masked by greater changes in the supports. When the level of contact was substituted for the microscopes, or when Mr. Saxton's reflecting pyrometer was employed, these changes became very perceptible, and it was necessary to resort to direct experiment upon the materials of the bars themselves to obtain even approximate compensation, and then to correct a small residual quantity by applying a covering more absorbent of heat to one bar than to the other. If such changes have not been perceived hitherto, it has been because adequate means were not used to detect them. I am indebted to Lieutenant A. A. Humphreys, and to Mr. Joseph Saxton, for the perseverance and skill

with which the experiments necessary to a complete adjustment of the apparatus were made.

3. The lever of contact and level first used, I believe, in the adjustment of standard measures by Bessel, was applied to indicate the lengths of the bars. The levels were so delicate, that several divisions upon them made up a quantity entirely insignificant in the measurement. The doubt which I had was, whether the sensibility of the apparatus had not been carried too far. This was, however, entirely removed upon finding the rapidity and certainty with which it could be used. The contact of two adjacent measures was between a blunt knife edge and a plane of agate.

4. The trussed support for the bars adapted to bearing the apparatus at two points only, and the tin covering or tube which surrounded the whole, were similar in principle to those used by Mr. Borden, but differed entirely in the adaptation of them; the bars moved freely on the trussed frame upon rollers, and were not attached to the covering tube in which the trussed frame itself was merely supported. The tin covering was conical and was doubled.

5. The trestles admitted of the various motions required in placing the apparatus. The length of the whole, about twenty feet, (six metres,) gave a weight which permitted easy and rapid transfer by four men, when covered with several thicknesses of imperfectly conducting material to keep the fluctuations of temperature within moderate limits. In arranging so many and various details, it is not to be expected that some of them will not admit of improvement; but the performance of the apparatus was highly satisfactory, working with a rapidity and accuracy quite going beyond my most sanguine expectations, and making comparatively light the labor of all concerned by the excitement produced by expectations constantly surpassed. The contacts were usually made in much less time than the setting of the forward trestles for the next measure. The following statistics of the measurement will suffice for the present to show that we have obtained a useful auxiliary in a geodetic survey, especially when the difficulties of triangulation render advisable the measurement of frequent bases.

The greatest length measured in the course of a day, in the final measurement, was 183 tubes, equal to nearly seven-tenths of a mile; the least, 47 tubes, or one-fourth of a mile; the average, 104 tubes, or four-tenths of a mile. The whole measurement of nearly seven miles was completed in seventeen working days, not reckoning the time lost by bad weather, or occupied by change of camp, and by comparisons of the apparatus. The length of the apparatus was compared before and after the final measurement with a standard iron bar, with which it had been compared in the office, by using Mr. Saxton's reflecting pyrometer.

The accuracy with which a remeasurement of considerable length could be made, was tested more than once in the measurement, but it was determined to make a more complete direct trial by establishing intermediate marks, and noting by the micro-telescopes attached to the ends of the bars the deviation at intervals. The greatest deviation in the length of seventeen tubes was between one and two hundredths of an inch; the average in twelve cases of repetition, not regarding signs, was five thousandths of an inch, the final error at the end of the third of a mile remeasured was nothing. The probable error of remeasuring 112 yards was five thousandths of an inch, making in the whole length of the base, and supposing all the errors to fall in the same direction, which is physically most improbable, about five-tenths of an inch. The great practical difficulty found at the outset, was to obtain a mark which would stand unmoved in the sand, to which to refer the apparatus on recommencing a measurement; this was satisfactorily obviated after many experiments, and the marks, which I have just stated to have been placed at intervals, may be assumed generally to have been stationary from one measurement to another. Incidentally, this remeasurement gave a strong test of the perfect compensation of the apparatus, under sudden changes of temperature as well as for different stationary temperatures. A storm came up after the second measurement was commenced, which interrupted it for between one and two hours, and cooled the air suddenly about four degrees. The second measurement was made at a lower temperature by some five degrees than the first, and under exposure to a sudden fall of temperature.

At the nearest whole measure to each mile, stone posts were planted in the sand and duly secured, and at the ends of the base, monuments were erected and secured with great care to mark the extremities of the line. Smaller stones were also placed in the prolongations of the base and across it at the ends, giving lines intersecting upon the extremities of the base line. Full descriptions of these monuments and stones, and of their condition at the close of the work, have been recorded in the office of the survey. They have been visited once since the measurement by assistant Gerdes, and their condition reported. The whole time occupied by my party at the base, including the landing and reshipping of the apparatus, the pitching and striking the camp, and its removal from the east end towards the west end, the measurement, placing monuments, trials of apparatus, &c., was six weeks, namely, from the 30th of April to the 12th of June. The final measurement (occupying 27 days) was commenced on the 12th of May and ended with the 8th of June, including in this period three days, when the camp was removed, and four Sundays. We were much indebted to Major Ogden, of the corps of engineers, for the important facilities which he afforded us.

Laignel's Safety Brake.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

M. Laignel has proposed a safety brake for railroad cars, (patented in 1841.) consisting of a sliding piece, the lower part of which fits accurately upon the top of the rails; this is attached by means of four levers, to a vertical axis passing through the bottom of the car, equidistant from the four wheels, so that by turning a handle, the brake may be raised or depressed vertically. When not in action it is raised a little above the rail, but by a simple revolution of the handle it may be pressed against the rail, and be made to check the velocity of the car by its friction; when required, the pressure may be carried so far as to lift the wheel off the rails, and leave the car resting upon the brake-pieces (which are of considerable length). and thus the whole weight of the car is rendered effective by its friction in arresting its progress.—*Bull. de la Soc. Indust. Nat., August*, 1847, *p*. 401.

Artesian Well at Venice.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

In an artesian well sunk at Venice, for the purpose of supplying the city with fresh water, four beds of turf were traversed, at the respective depths of 97, 157·5, 279, and 412 feet. They show that at four different epochs, the soil, which was gradually sinking, was covered to a slight depth by fresh water. Water was met with at the depths of 16, 131, 174, and 197 feet. This latter water, which rises about 10 feet above the level of the lagunes, appears to have its origin in the marshy plains, which surround them; an origin which appears to be confirmed by the carburetted and sulphuretted hydrogen gases which escape from the water, and the large quantity of azotized matter which it contains, not sufficient, however, to render it unhealthy, or unfit for use.—*Ibid. September*, 1847, *p*. 558.

Speed of Ocean Steamboats.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Baron Seguier states that he saw, when at Havre, two English steam packets, the Success and the Express, which make the trip from Havre to Boulogne, which is 240 kilometres, (149 statute miles,) in 5 hours. These boats are very long, shaped like piroques, and carry their sails arranged in a new way, so that they can take advantage of the slightest wind, without losing the necessary stability of the vessel. Their engines are 350 horse power, built by Maudsley, on the annular system, which presents several advantages over the oscillating cylinders. —*Ibid. September* 1847, *p*. 570.

BIBLIOGRAPHICAL NOTICE.

Principles of Physics and Meteorology, by J. MÜLLER, *Professor of Physics at the University of Freiberg. First American edition, Revised and Illustrated with* 538 *Engravings on Wood, and two Colored Plates.*

This is the first of a series of works got up by Bailliére of London, in a beautiful style, and profusely illustrated with excellent wood-cuts; the book before us is a reprint by the American publishers.

The style of the getting up of the book is very creditable, but we are glad to see that the works which are to follow, are intrinsically of a much better character. What the original may be we cannot say, but Prof. Müller's name is sufficiently well known to protect him from the suspicion of having written some, at least, of the blunders which are so rife, especially in the mechanical part of the book, and we suppose they may be fairly attributed to the ignorance of the translator, who manifestly had no knowledge whatever of the subject. The American editor has suffered his name to remain unknown—and he has done wisely—for had he attempted to rectify the work, he must have made it his own; whereas he has added a paragraph or two on well chosen subjects, such as the steam engine and Morse's electric telegraph, has translated the French weights and measures into English, which the original translator probably could not do, and has not corrected even the manifest typographical errors of the English book. In justification of our remarks, we ask the reader who has access to the work, to turn over its pages and read a paragraph here and there, especially in the mechanical part, and we feel sure that he will agree with us, that it is precisely such a book as, tempting the unlearned mechanic, by easy reading and handsome pictures, gives him false ideas of what it pretends to teach, so that his latter state is worse than the first. We give a few illustrations taken at random in justification of our remarks:

"All bodies are in one of these three conditions: either solid, *fluid*, or gaseous." (p. 31.)

"If we remove a piece of stone from the ground and *throw it from our hand, it will, when left to itself*, fall until it reaches the earth, &c." (p. 34.)

"Any certainty other systems (of measures) now possess, has been derived from a comparison with the system established in France." (p. 36, note.)

"*The mass of a body is always proportional to its weight.*" (p. 37.)

"In order to determine the specific gravity of solid substances, we must form from them a body of regular shape, as a cube or sphere, in order to estimate the more readily its cubic contents." (p. 40.)

These are enough from ten pages of the elementary part of the work,—but the rest of the treatise on the mechanical powers is about equally good, and the attempt to define and classify pullies is particularly amusing.

On page 73 we have glass twice mentioned as deficient in elasticity, once ranked with lead, and again contrasted with steel, which is perhaps, of all others, the solid which it most resembles in its physical properties. On the same page we have the following: "*absolute strength* is the force by which a body resists being torn asunder, when it is stretched lengthwise. This resistance evidently depends upon the *diagonal* section of the body to be severed, and is proportional to it." Here the translator has evidently confused the author's meaning, giving *diagonal* for *transverse*; as it doubtless precedes it in his dictionary.

On page 111 is a perfectly original attempt to account for the aggregation of mercury and water in spherical drops. The ordinary theory of attraction of cohesion is rejected, because it only acts at insensible distances, and the drop has a sensible size, and then follows an explanation which we commend to the reader, for it is too long to extract. But the termination is too good to be omitted. "A liquid *strives* therefore to terminate in a plane surface, but a mass, free on all sides, cannot be surrounded by one single plane."

On page 117 the translator recommends an experiment upon the weight of air, by hanging a *balloon*, furnished with a stop cock, to one arm of a balance. We say the *translator*, for the French use *ballon de verre* to signify a glass globe, which is what the author meant and doubtless said.

Again, if any of our readers have an extra stock of patience, and no trials to wear it out on, let them try the demonstration of the law of variation of atmospheric pressure given upon page 131, where a method originally bungling enough, has been so nicely complicated by what we take to be two typographical errors in the mathematical signs as to be very nearly incomprehensible. We must do the American edition the credit to say, that it is a literal copy of the English, errors and all.

But enough of this; it is very evident that the author knew but little of mechanical philosophy, and that his translator knew not even the meanings of the terms. What the American reviser knows upon the subject does not appear. The rest of the book is much better. The article on sound is generally good, and the wood cuts, especially those of the organs of hearing, are admirably well done, and are very instructive. The article on light, we have not had time to read, but the illustrations are beautiful.

That on magnetism is good, though not a little disfigured by the ignorance of the translator. The same thing occurs in that upon electricity, where, for instance, the two fluids in presence of each other, as in the case of the charged Leyden jar, are spoken of as combined. There is also an American error of the press in the wood cuts 371 and 372, and numerous typographical errors have slipped uncorrected from the English into the American edition. Indeed, it is curious too, that a work should be produced at this time in England, in such an attractive style, and so totally negligent of English contributions to science. The constant battery, invented by Daniell, is ascribed to Becquerel, who, we are aware, claimed it, but failed entirely to substantiate the claim. The contact theory of Germany is given, in total exclusion of the more comprehensible chemical theory now almost universally adopted in England and France, especially since the experiments of Faraday, which are alluded to by the author, but merely alluded to. Surely if the English translator had been familiar with what had been doing for the last ten years in his own country, this scandal would not have been permitted.

In fine, the article upon heat will probably be found to be the best in the volume, since, so far as we have had the patience to compare them, it is nothing but a copy of Pouillet's article upon that subject, in his Traitè de Physique, where even the figures are to be found. We conclude, then, as we began, that we are glad to know, that the works of this same series to come hereafter, are of a much higher order of merit, and that their scientific value will be more worthy of the trouble and expense bestowed upon them. F.

AMERICAN PATENTS.

List of American Patents which issued in the month of January, 1847, *with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in Clocks and Time Pieces;* Chauncey Boardman and Joseph A. Wells, Bristol, Hartford county, Connecticut, January 1.

The patentees say,—"The nature of our invention consists in placing the driving spring upon the same shaft with the fuzee, connecting the shaft of the combined fuzee and spring to the frame of the clock movements, and attaching one end of this spring to the frame of the clock movements."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the placing the driving spring and fuzee on the same shaft, connecting the same to the movement frame of the clock, and the combination of the same with the barrel and movements of the clock, substantially in the manner and for the purposes set forth."

2. For *Improvements in the Apparatus or Truss for the cure or relief of Prolapsus Uteri;* Frances Carter, Washington, Rappahannock county, Virginia, January 1.

The patentee says,—"The nature of my invention consists in combining two uterine supporting pads with an abdominal and a dorsal pad, or with either of them, in such manner that they (the uterine supporting pads) shall act upon the pelvis on each side of the labia, for the purpose of giving equal or better support to the uterus than can be given by the single perineal pads generally made use of; and of obviating the objections thereto, such as inconvenience in the use, injury from moisture, &c."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the making use of two uterine supporting pads, arranged in such a manner as to act on the pelvis on each side of the labia, and also their combination with an abdominal and a dorsal pad, or with either of them, substantially as herein set forth."

3. For an *Improvement in the Machine for Cutting and Harvesting Grain;* Clinton Foster, Laporte county, Indiana, January 1.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is the combination of the cutting and threshing apparatus described, in one harvesting machine: connecting the knives separately with the respective rods and the eccentrics, and their arrangement and combination with the guides and cutting plate, being a spur and balance wheel combined."

4. For an *Improvement in the Machine for Excavating, Grading, and Solidifying roads;* Nathan Parkins, Frederick county, Virginia, January 1.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combining the scraper with a wheeled carriage or cart, in such a manner that it may be thrown into and out of action, and be regulated by an attendant upon the cart, by means of the elevating and depressing levers and the scraper handles, the whole being combined and operating substantially in the manner and for the purpose herein set forth."

5. For an *Improvement in Carriage Wheels;* Ira Holmes, Moscow, Lexington county, New York, January 1.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the herein described method of inserting metallic spokes in carriage wheels, in combination with the making of the hub in two parts, one fitting within the other, substantially as described, whereby the spokes are firmly held in place and prevented from working loose by the jarring of the wheel, and also any one of them can be taken out for repairs and reinserted, by making the hub in two parts as described."

6. For *Improvements in the mode of attaching Traces or Tugs to the Whiffle Trees of Vehicles;* Winant de Garmo (assignee of W. S. Ellison) Northumberland, Saratoga county, New York, January 5.

Claim.—"What I claim as my invention, and desire to secure by letters patent is the mode of attaching traces, &c., to the whiffle trees of vehicles, as herein described, viz: by rounding off the end of the whiffle tree and passing the end of the trace through a loop attached to the same; which end may be secured to the back of the whiffle tree either in the mode herein described, or in any other suitable manner.

"I also claim the peculiar mode of securing the end of the trace or strap to the whiffle tree, by the use of the button-headed stud and slats, as set forth and described."

7. For an *Improvement in Mills for grinding Grain and other substances, and drying or curing Flour or Meal;* Jean Baptiste Gendebien and Auguste Houyet (assignors to F. B. Hyde, of New York), Brussels, Kingdom of Belgium, January 5, 1847—antedated, U. S., February 11, 1846.

This is for the purpose of drying flour to prevent the necessity of kiln drying, and at the same time avoiding the burning of the flour by the clogging of the furrows, by forcing currents of heated air into the eye of the runner, and causing it to pass out radially between the staves.

Claim—"We wish it to be understood that we do not confine ourselves to the particular arrangement laid down in the drawing, nor to the position or form of the invention as there represented. But we claim as our invention, the causing of a current of air to pass between the mill stones from the eye, towards and out at the periphery, substantially for, and in the manner described, the said current being produced by a blower or any other convenient mode, either by drawing the same from the mill, or forcing it through, as fully described above.

"And we also claim drying or curing the flour or meal while under the action of the mill stones, by the introduction of a blast of heated air, substantially as described."

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8. For an *Improvement in the apparatus for Arresting and Consuming Sparks, and creating Artificial Draft;* James Montgomery, Memphis, Tennessee, January 7.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode herein described of creating draft, in chimney stacks, by means of the screw fan attached to the plate placed at the top of the stack, substantially in the manner described. And I also claim the above in combination with the perforated casing and shield, and in combination therewith, the tube, or trunk, and valve placed within it; all in the manner and for the purpose described."

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9. For an *Improvement in Toasting Coffee, called "Self-Toasting Aroma-Condensing Apparatus;"* John R. Remington, Baltimore, Maryland, January 7.

The patentee says,—"The nature of my invention consists of a metallic wheel of buckets, somewhat similar to an overshot water wheel, but of small diameter, the buckets of which receive the grains of coffee that drop one by one from a hopper above, and which, by their weight, turn the wheel that carries the grains slowly through a circular trough below, that extends around about one third the circumference of the wheel, and which is sufficiently heated by a small furnace to toast the coffee during the time that it is carried from one end to the other, when it is discharged by means of an inclined spout into a vessel below, where the aroma is condensed by cold water in a pan above; the buckets of the wheel being so formed as to contain the requisite quantity of coffee, to insure the turning of the wheel by the weight thereof, and so curved near the periphery as to drag the grains through the trough and up to the spout, and the hopper being provided with a hinged shute, the inclination of which can be increased or decreased to regulate the delivery of the grains of coffee into the wheel, whereby the motion of the wheel is gauged to the temperature of the furnace."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method, substantially as herein described, of toasting coffee by means of a wheel of buckets, which receives the grains of coffee from a hopper—when this is combined with a heated trough through which the grains are passed by the rotation of the wheel, as herein described. And I also claim, in combination with the wheel and trough, the condensing vessel for the purpose of condensing the aroma of the coffee, substantially as herein described."

10. For a *new and improved method of applying what are called by Tailors, the "Scye and Shoulder Measure for Cutting Garments;"* Miles G. Simril, Chester, South Carolina, January 7.

The patentee says,—"My invention consists, in part, in providing a spring-steel ring which I call the 'circular measure,' and which being set to the exact size of the scye-joint of a person, and properly located on the cloth from which the garment is to be cut, will represent, *on the cloth*, the scye-joint of the person, and act as a guide to the application of the 'shoulder measure.'"

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the spring-steel ring herein described, and called the 'circular measure,' and the 'shoulder regulator' thereto attached, which are manufactured and used in the manner herein set forth."

11. For an *Improvement in the machine for making Tin Ware, called the "Tin Raising Machine;"* Alonzo Heaton, Irving, Chatauque county, New York, January 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the concave with the cone for raising or making a concave plate of tin or other metal, as described."

12. For an *Improvement in the Knife for Cutting Timber, called the "Reversible Scolloped-edge Knife;"* Issac Crossett, East Burlington, Burlington county, Vermont, January 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the particular manner of combining and arranging the peculiarly constructed cutters, with the scolloped-backed stock, as set forth."

13. For an *Improvement in the Water Closet;* James Ingram and James Stuart, City of New York, January 15.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is surrounding the basin with a dip flanch, when this is combined with the pan for containing water, substantially as described, whereby the escape of noxious odors is prevented when the basin is removed, and the necessity of uniting the basin with the top of the trunk avoided, as described. And we also claim the second jointed pan, for preventing the escape of odors when the first pan is opened, when this is combined with the first pan, substantially as described."

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14. For an *Improvement in the Fountain Pen, Shaft, and Pen Holder;* Walter Hunt, City of New York, January 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, in the above described fountain pen, is the filling tube of a graduated capacity for filling the pen, combined with the fountain pen, as above set forth and specified, or arranged in any manner which is substantially the same."

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15. For an *Improvement in Ploughs;* Lorenzo Prouty, (executor of David Prouty) of Dorchester, Norfolk county, Massachusetts, January 13.

Claim.—"What is claimed as the invention of said David Prouty, and is sought to be secured by letters patent, is the adjustable and shifting wing, or wings, in combination with the mouldboard, as described, by means of which the same plough can be adjusted to the cutting of furrows of different widths, as set forth."

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16. For *Improvements in the machine for Splitting or Cutting out Plank, &c.;* I. R. Remington, Lowndes county, Alabama, and Robert Beale, Washington, District of Columbia, January 15.

The patentees say,—"The nature of our invention consists in the application of a double series of cutters, placed in line with each other; the first cutters of the series are made blunt on the edge and serve only to mark a short distance into the surface of the plank to be cut; the second pair are thinner, and are placed closer together, and they of course go deeper, and so on through the series, each successive pair being made thinner, and marking or cutting deeper, till the last pair meet in the centre, or nearly so."

Claim.—"Having thus fully described our improvements, what we claim as our invention, and desire to secure by letters patent, is, the employment of a series of cutters, the first of which has a blunt edge for indenting the surface instead of cutting it, the successive cutters being made progressively thinner, and cutting deeper, to the centre, all substantially as described."

17. For an *Improved Fountain for Shower Baths;* Henry Blodgett, Albany, New York, January 15.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode in which I have constructed and arranged the filling passage and the rose, as set forth and described, both being at or near the top of the fountain when erect, (it being understood that I do not intend to confine my claim to the case where the partitions inclosing the empty cavities are introduced, those latter not being absolutely necessary to, although greatly improving the action of, the apparatus). And in combination with the above, I claim placing the gudgeons upon which the fountain turns, *above* the centre of the cylindrical water receptacle; and adding a counter weight to the bottom of the latter, so as to cause the apparatus to right itself after inversion. I also claim the peculiar manner in which I have arranged the escape passages so as the more readily to cut off the water when the fountain commences to rise from its inverted position, and thereby prevent its spouting to the front. And I further claim the mode of producing the *drench*, by means of the cover applied over the rose—the whole being constructed and operating substantially in the manner and for the purpose set forth and described."

18. For an *Improvement in the Machine for laying Cables, Ropes, Twine, and Cordage of all kinds;* William Joslin, Waterford, Saratoga county, New York, January 19.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st, the combination of the revolving condensing tube with the stationary laying block, the former being constructed and operated in the manner and for the purpose set forth.

"2nd, the combination of the adjustable frustrum of a cone with the revolving shaft and condensing tube, for graduating the tension of the strands during the operation of laying them, as described."

19. For *Improvements in the machine for Cutting or Forming Irregular Forms on Wood or other Substances;* Timothy Clark, New Haven, Connecticut, January 19.

The patentee says,—"The nature of my invention consists in placing the axis of rotation of the cutter wheel, or wheels, at right angles to the axis of rotation of the pattern and substance to be wrought into the desired form, when this is combined with an arrangement of machinery by which the pattern and article to be shaped are made to rotate during the operation of the cutter wheel."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the cutter wheel or saws, so as to cut in the direction of the grain of the wood, or other substance to be formed, when this is combined with the rotation of the pattern, and substance to be formed, during the operation of the cutters, substantially as described."

20. For an *Improvement in Horse Rakes;* Lewis Swift, Clarkson, Monroe county, New York, January 19.

Claim.—"What I claim, and desire to secure by letters patent, is the curve in the handles, in combination with the blocks affixed to the teeth, in the manner and for the purpose set forth."

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21. For an *Improvement in Hammers;* Charles Hammond, Philadelphia, Pennsylvania, January 19.

Claim.—"Having fully described the nature of my improvement in the manner of manufacturing claw, or other strapped hammers, what I claim therein as new, and desire to secure by letters patent, is the manner herein set forth of forming, and of confining the straps in place; the straps consisting of strips of iron of any equal thickness from end to end, and being beveled or dovetailed at their edges, to fit corresponding bevels in the eye, in the particular manner set forth."

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22. For an *Improvement in the manner of constructing Lamps for burning Volatile Ingredients;* Isaiah Jennings, City of New York, January 19.

The patentee says,—"The general construction of my improved lamp, is the same with that for which I obtained letters patent, in which the volatile mixture was made to ascend in a wick of cotton or other fibrous material, contained within a tube, in the upper part of which it is converted into vapor, and is allowed to issue from small orifices, where it is ignited and burns in the manner of gas lights. My improvement in this lamp consists in so constructing it, as that by turning the burner around to a small distance, the number of jets may be diminished, or increased, at pleasure, or the whole may be extinguished."

Claim.—"What I claim therein as new, and desire to secure by letters patent, is the so arranging of the tubes, and of the apertures through them, as that the outer tube shall, by turning on the inner, be made to vary the number of jets, or to extinguish the whole at pleasure, substantially in the manner herein fully made known; and this I claim whether the proportions for the jets be made to coincide precisely in the manner set forth, or in any other that is substantially the same, producing the same effect by equivalent means.

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23. For an *Improvement in the machine for Mortising Window Blinds;* Joseph W. Ingle, Upperville, Fauquier county, Virginia, January 21.

The patentee says,—"The nature of my invention and improvement consists in securing two stiles of a window blind, to the sides of a notched gauge bar, by means of arms extending from the sides of said bar, and a key which enters said mortises in the stiles—the teeth on the side of the gauge bar being made as far apart as the required distance apart of the slats of the blinds, said teeth being brought in contact with the spring dog, attached to the frame for holding the gauge bar, and stiles, in the required position, during the operation of mortising; the stiles being then moved by the operator between two cutters having a simultaneous action, by means of a vibrating lever, moved by the operator, to which the cutters are attached by slides, straps, or pins, or other more suitable contrivances, by which arrangement and mode of operation, two mortises are cut, one in each stile, at each movement of the lever. The operator holding the stiles in his left hand, and the lever in his right hand, and moving the stiles forward towards the cutters, one notch for every movement of the lever."

Claim.—"What I do claim as my invention, and desire to secure by letters patent, is the before described mode of mortising the stiles of window blinds, by securing two stiles to a notched gauge bar, and bringing the teeth of said gauge bar in contact with a spring dog, fixed to the frame between the two oblique cutters, attached by slides to a lever, which cutters are made to cut two mortises simultaneously, at each movement of the lever, one on each stile, and on opposite sides."

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24. For an *Improvement in the machine for Sifting and Cleaning Plantations and Farms, from Grass and other Rubbish;* Jean Blanc, New Orleans, Louisiana, January 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is a scoop, or shovel plough, in combination with the sifter, springs, and cams."

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25. For an *Improvement in the Pin for Fastening Clothing;* James Rabbeth, Mansfield, Connecticut, January 21.

The patentee says,—"The nature of my invention consists in providing a pin with two tubes, (one fastened to the head, and the other to cover the point when used, and removable therefrom at pleasure,) which tubes are connected together by means of an elastic band, in such a manner as to hold and keep the pin in its place, when worn or used, and to prevent the point of the pin from piercing, or otherwise in any manner injuring, the person wearing or using the same."

Claim.—"What I claim as my invention, and what I desire to secure by letters patent, is the combination of the tubes, caps, elastic bands, and pin, as hereinbefore described, so as to form a pin, in such manner as that, when used, the pin will be confined or held in its place, and the point thereof prevented from piercing, or otherwise injuring, the person wearing or using the same."

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26. For an *Improvement in the Faucet and Filter combined, for Purifying Water from Aqueducts, Reservoirs, or Hydrants;* Samuel H. Lewis, City of New York, January 26.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is the construction of the faucet plug or key, with water channels in its sides, corresponding with the orifice in the water pipe, and with those in the sides of the socket, whereby the direction of the flowing water is occasionally reversed, and made to pass through the filter, in opposite directions; also the combination of the faucet key, and socket, with the filter and filter chambers as described."

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27. For an *Improvement in the Steering Apparatus, or Wheels for Ships, &c.;* Jesse Reed, Plymouth, Mansfield, Massachusetts, January 26.

Claim.—"What I claim as my invention, and desire to have secured to me by letters patent, is the arrangement or combination of two endless screws, (geered together as described,) with a wheel on the top of the rudder post, having teeth on the interior of its rim or periphery, as set forth, and also any contrivances varying therefrom, but substantially the same, and combined substantially in the same manner, and for the same purpose."

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28. For an *Improvement in Planing Planks and Boards;* Job Sheldon, New Haven, Connecticut, January 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination and arrangement of the two edged horizontal planing cutters, with the vibrating frame, forked lever, and the connecting rod, constructed and operating substantially as herein described."

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29. For an *Improvement in constructing Presses, for Compressing Bales of Cotton or other Substances;* Alfred C. Jones, New Orleans, Louisiana, January 26.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combination of the link with the arm, and of the latter with the shaft, by which the mechanical effect of the leverage is increased, as the pressing proceeds.

"I also claim the manner of regulating the rise of the follower, to adapt it to bales of different sizes, by a self-adjusting apparatus, consisting of the sliding boxes for the gudgeons of the shaft, the stud, the inclined plane, and the weight and jointed levers, and arranged and operating substantially as set forth."

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30. For an *Improvement in fastening the Tug or Draw Strap of a Harness to the Hames Tug;* William D. Hillis, Cuyahoga Falls, Summit county, Ohio, January 26.

The patentee says,—"The nature of my invention consists in the construction of an apparatus which will serve all the purposes of the common buckle, without the use of the *tongue*, and the consequent necessity of perforating the draw strap with holes, and also the convenience of taking up, or adjusting the draw tug, to any desired length."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application, for the purpose of holding and fastening the tug of a harness, of the plate with the roller, between the tug to be held, and the back plate of the box, in the manner described."

31. For an *Improvement in Smut Machines;* Joseph Heygel, Baltimore, Maryland, January 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the case of a horizontal smut machine, with two rows of holes in the sides thereof, in the manner described, for ventilating and discharging the smut, and, in combination therewith, the runner, constructed as set forth, for the purposes specified."

32. For an *Improved method of Traversing Wires across Rivers or Hollows, for the purpose of forming Suspension Cables, for the Support of Bridges;* Jno. A. Roebling, Saxonburg, Pennsylvania, January 26.

Claim.—"What I claim as my original invention, and wish to secure by letters patent, is the application of *traveling wheels*, suspended and worked, either by a double endless rope, or by a single rope, across a river or valley, for the purpose of traversing the wires for the formation of *wire cables*—the whole to be in substance, and in its main features, constructed and worked as described."

33. For an *Improvement in Metallic Tension Wheels for Carriages, &c., &c.;* James Rowe, Hamilton, Ohio, January 26.

Claim.—"That which I claim as my invention, and desire to secure by letters patent, is, 1st, the centre cylinder, comprising one-third of the whole length of the hub, (more or less,) in combination with the end pieces, and the heads on the inner ends of the spokes.

"2nd, I claim the *swells* at each end of the spoke rods, for the purposes and ends herein described."

We are indebted for the following report to its distinguished author. We publish it for the benefit of future applicants to Congress for renewals of patents, and because it contains a very definite and lucid exposition of a principle which ought to govern in all such cases, but has been heretofore too much neglected. COM. PUB.

SENATE U. S.—*Mr. Westcott, from the Committee on Patents and the Patent Office, to whom was referred the petition of Herrick Aicken, praying an extension of his patent for "an improvement in the saw-set," &c., made the following report:*

That a similar petition was presented to the Senate, February 3d, 1845, and referred to the same committee. No law passed in accordance with the prayer of the petition.

The following are the only papers filed with the petition:

1. A paper purporting to be a printed copy of his letters patent and specifications, &c., dated 24th of March, 1833, not certified or otherwise authenticated.

2. A paper purporting to be a printed copy of his protest against the decision of "*the board*" refusing to extend his patent. This appears to have been addressed to Mr. Ellsworth, former Commissioner of Patents, &c., and is dated June 4, 1844. It is not authenticated.

3. A printed schedule of articles stated to be improvements and inventions of the patentee, not authenticated, but of which articles he states specimens are deposited in the Patent Office.

4. A printed handbill or advertisement, with woodcuts of the invention of the petitioner, for which he desires his patent renewed.

The petitioner has neglected to adduce to the committee any evidence whatever, except that furnished by these papers. The testimony before the board, and upon which it refused to extend his patent, has not been laid before the committee, though the petitioner asks that Congress shall in effect, by a special act, *reverse* that decision. Without some *proof* of circumstances showing that petitioner should have granted to him an extension of his patent, as prayed by him, either from considerations of public benefit, or on account of his superior claims from other considerations, Congress should not grant his application. Nor should he expect that the committee will seek to ascertain where the *proofs* of the merits of such application may be found, beyond the testimony filed with the petition, and then to search for, and adduce them. The petitioner must procure and present them with the petition.

Prior to the act of 4th July, 1836, regulating the Patent Office, (vide 5th vol., stat. at large, pp. 117, 124,) patents were extended or renewed only by special act of Congress. Adopting the liberal principles of Lord Brougham's bill amending the patent laws of England, passed in 1835, (vide Kingley's and Prisson's Patent Laws, pp. 77, 79, &c.,) Congress, by the 18th section of the law before cited, made the Secretary of State, the Solicitor of the Treasury, and the Commissioner of Patents a "*board*" to receive applications for the extension of patents, prescribing, with great particularity, the mode of proceeding by the applicant, the character of the testimony he should adduce to the board, and the principles by which it should be guided in the extension of patents.

These provisions are liberal to a patentee who may not have received adequate remuneration or reward for his invention. They are general, embracing nearly every case in which a patent should be renewed.

If cases occur of peculiar character and merit, which, from extraordinary circumstances, may not be within these provisions, and as to which the board have no *power* to grant an extension, and in which the patentee can show grounds for an application to Congress for special relief, it is not denied that Congress may and should extend such relief. Cases may possibly happen, also, in which, though the board had full jurisdiction, its decision, refusing to extend a patent, should not be conclusive upon Congress, and in which upon application of a patentee, Congress should even disregard such decision of the board, and extend the patent by a special law. But special legislation should always be avoided, except in cases of peculiar and extraordinary merit and necessity. The primary object of the 18th section of the act of 1836, was to provide an impartial tribunal for the decision of such questions upon settled rules and principles, and avoid the necessity of applications to Congress for such special laws. Patentees, having full remedy under the general law, by application to the board, as the law prescribes, should be discouraged from applying to Congress, by a denial of the relief sought, till they resort to such general remedy provided by that general law; and which, it is repeated, is of the most liberal character. It is true, by the constitution of the United States, (vide Art. 1, amendments,) Congress cannot make any law "abridging the right of petition;" but the action of Congress upon petitions unnecessarily or improperly preferred, may, with entire propriety, be such as to discountenance their presentation. It has been urged, that it is not an abridgment of this franchise of petition for the redress of a grievance, public or private, to require that it shall not be prostituted by its use as the medium of proclaiming treasonable, or incendiary, or immoral sentiments, hostile to the constitutional institutions of the country, or libellous with respect to individual citizens, and also to prohibit the use of insulting and disrespectful language towards the body to which it may be addressed; but differences of opinion have existed as to the extent to which such restrictions may be rightfully enforced by Congress. These rules do not, however, apply to the principle just advanced with reference to respectful memorials upon proper subjects, and as to the form, and style, and length of which, the citizen may rightfully consult his own taste and fancy. Either house may, by its rules, prescribe what a petition for the extension of a patent or for any such special law shall set forth, and the character and degree of proof that shall be adduced to entitle it to favorable consideration, even though it may not refuse to *receive* petitions on such subjects not conforming to such rules.

The multiplicity of recent applications to Congress for the extension of patents by special act, has induced the committee to make some suggestions as to the general rules and principles that should govern in regard to such applications, which it may be well for applicants to conform to.

In all cases, a copy of the patent sought to be extended, duly certified, and also of all official documents relating thereto, should be filed with the petition.

In no case where the board has, under the 18th section of the act of 1836, before cited, jurisdiction of an application to extend a patent, and in which no special reasons exist excusing the party for dispensing with such application, should Congress favorably entertain a petition to extend a patent until such jurisdiction has been resorted to. And, where reasons exist for not invoking the action of the "*board*," they should be distinctly stated and proved.

In cases where the board has no jurisdiction, and could not therefore extend the patent, that fact, and the reasons why the case is not within the jurisdiction of the board, should be clearly shown by applicants.

In all cases in which application has been made to the "*board*," and the extension refused, (as it is sought to rescind the decision of the *board*, and reverse it,) an exemplified copy of the application to the board, and of all the proofs before it, and of all its proceedings, should be filed by the petitioner, and the grounds for the application to Congress for the renewal or extension, should be explicitly and distinctly stated.

In all cases, full proof by affidavit of persons certified to be of good character, and entitled to credit, and disinterested in the matter, should be adduced, substantially as required by the 18th section of the act of 1836, to the following points:

1. As to the value, merits, novelty, and utility of the invention, its cost of manufacture or construction, &c.

2. As to the patentee's receipts and expenditures, respectively, in detail, as far as possible; as to his sales and expenses thereof; and as to the time, trouble, labor, and expense, in bringing his invention into use; and a faithful account of loss and profit in any manner accruing to him from and by his invention.

3. As to any litigation he may have encountered with respect to it, stating the same particularly, and the expenses thereof, and the result thereof.

4. Showing, that without fault or neglect on part of patentee, he has failed to obtain from the use or sale of his invention a reasonable remuneration for his time, ingenuity, expense, labor, trouble, &c., bestowed upon the same, and the introduction thereof into use.

5. As to all transfers or assignments he may have made of such patent right, or of the right to use the thing patented, and showing that such assignees, and others interested, have notice of the application to Congress for such extension, so that injustice may not be done to third persons by their not being apprised of such application, and being therefore without opportunity to oppose such extension. If Congress is without power to prescribe, in advance of such petition, that it will not *receive* it until such full public notice is given, it is not to be doubted that its action upon such petition may, and properly should be, influenced unfavorably, unless full notice is given to the world, and especially to those who may be interested, to dispute the claim of the petitioner to the extension asked. Notice is required by the 18th section of the act of 1836, upon an application for an extension to the "board." As the patent is not conclusive evidence either of the novelty and utility of the thing patented, or that the patentee is the inventor, (vide section 15, act of 1836, *et passim*,) all who may dispute the validity of the patent on such grounds, should have fair opportunity of being heard before the enactment of a special law which may conclude them, and the petitioner should be prepared to show he is the *inventor*.

6. If any special circumstances exist in a case entitling a petitioner

to the favorable consideration of Congress, they should not only be distinctly stated, but *proved.*

7. All papers filed should be legally authenticated.

The absence of the proofs above stated, or disregard of the rules suggested, should, in every case, cause the rejection of an application for an extension.

Elaborately extended statements, essays, arguments, and explanations in writing and letters from public men, or importunate verbal solicitations should not be regarded as supplying the place of *proofs.* In all cases that have been at prior sessions before Congress, the dates should be specifically stated as well as the action had thereon, referring to the Nos. and pages of the documents. The constitutional power of Congress to require by law that petitions of any character, or the testimony to sustain a petition, shall be *printed* in advance of presentation, by a petitioner, may be questioned; but all may understand that the great facility afforded for the speedy examination of a case by the printing of the papers exhibiting its merits, and the furnishing each member with a copy, should be a sufficient incentive to cause an applicant for any relief by special act, to adopt such a course. If they will present petitions written so that it is difficult to decypher them, accompanied by a mass of ill-arranged papers, many often wholly irrelevant, it is not strange that delays arise from the inability of committees and members to examine the cases properly. Applicants may find it beneficial not to disregard this suggestion.

Instances have heretofore occurred in which patents, involving interests to the amount of hundreds of thousands of dollars, have been extended by special act of Congress, and which acts have been complained of as doing injustice to the parties not heard, or whose rights were not considered by Congress. A memorial has, at this very session, been referred to this committee, praying Congress to repeal an act passed in 1845, which extended a patent, in which memorial, signed by sundry citizens of Massachusetts, the express ground is taken, and the express allegation made, that the enactment of the law was procured by "misrepresentation" and by "fraud!" Strict adherence to the rules above suggested, may prevent this accusation being made in future. Another preventive is, the incorporation, in every act extending a patent where there are assignees, of a provision protecting assignees.

The committee, in the particular case under consideration, inasmuch as it does not conform to these rules, and as no evidence has been adduced, report the following resolution:

Resolved, That the prayer of the petition of Herrick Aicken should not be granted.

SPECIFICATION OF ENGLISH PATENTS.

Specification of a patent granted to PAUL GILBERT PRELIER, *of Rue de Rivoli, Paris, in the kingdom of France, for improvements in the manufacture of dry sulphuric acid, and in the manufacture of smoking, or Nordhausen, sulphuric acid,—being a communication.*—[Sealed, 29th June, 1847.]

The patentee commences his specification by stating that, in consequence of the great affinity of sulphuric acid for water, it is difficult to concentrate the acid, even to 66° Baumé; therefore, in order to obtain dry sulphuric acid, he combines simplé sulphates with a fresh proportion of acid for the purpose of forming bi-sulphates, which he decomposes by the action of heat, and thus obtains dry sulphuric acid. The manufacture of dry acid naturally leads to the production of smoking or Nordhausen sulphuric acid, as the latter is formed by the addition of dry acid to sulphuric acid, which has been concentrated to 66°,—the specific gravity of the Nordhausen acid increasing with the quantity of dry acid added.

In carrying out the invention, the patentee prefers to employ 100 parts sulphate of soda, 2 parts sulphate of potash, and 2 parts sulphate of lime; but these proportions may be varied; and even if sulphate of soda alone be employed, dry sulphuric acid will be obtained. The mixture is put into freestone retorts, set in a suitable furnace; then, by means of a bent glass tube, the acid is introduced into the retorts, and heat is gradually applied. Shortly after the application of heat, drops of water will proceed from the retorts, then acidulated water, followed by acid at 40°, 50°, and 56°, and finally by acid which fumes or smokes. To enable the operator to judge correctly as to the progress of the operation, vessels containing water are placed to receive the drops of acid; and when each drop produces a sound resembling that which would result if a red-hot iron was immersed in the water, the acid that produces the noise is dry acid. Vessels, to receive the acid, are now placed below the retorts, and luted with clay; and the retorts are subjected to a strong heat, until the acid ceases to drop into the vessels. Dry acid is thus obtained; but if it be desired to obtain Nordhausen sulphuric acid, a quantity of acid, concentrated to 66°, must be introduced into the receiving vessels, when they are placed below the retorts; and, by the admission of the dry acid, the density of the acid in the receiver will be increased to 67°, 68°, and 69°, according to the quantity of dry acid that enters the receiver. By this means sulphuric acid is obtained perfectly clear, and never colored like the Nordhausen sulphuric acid, nor charged with earth or other foreign matters.—[*Inrolled, December,* 1847.]

Lond. Journ. Arts & Sci.

Specification of a patent granted to Harry Joseph Perlbach, *of the city of Hamburgh, Founder, for an improved method or methods of uniting metals and alloys of metals.*—[Sealed, 23rd July, 1847.]

This invention consists in a method of uniting metals and alloys of metals of different properties and values, as, for example, wrought-iron and cast-iron, copper and cast-iron, &c., whereby compound pieces of metal, suitable for girders, ribs, beams, gudgeons, railway chairs, wheels, axles, and other parts of machinery and mechanical structures, may be produced, possessing all the aggregate weight and cohesiveness required, but much harder and stronger in some parts (such as those exposed to friction or direct strain) than in others.

When it is desired to unite wrought-iron with cast-iron, (for instance, to make a rectangular beam, one-fourth of the thickness of which shall be formed of wrought-iron, and the remaining three-fourths of cast-iron,) the mode of proceeding is as follows:—The piece of wrought-iron is first freed from oxide, by being immersed for a short time in a bath of nitric acid (or any other suitable acid) diluted with water, then taken out, made red hot, and again plunged into the bath. After which, in order to get rid of any acid that may adhere to the iron, it is washed with an alkaline solution; (for example, a solution of sal-ammoniac;) it is then immersed in a bath of melted tin, and left therein until it is well tinned all over. The tinned wrought-iron is next coated on that side where it is to be united to the cast-iron with an alloy or solder, composed of five parts of copper and ninety-five parts of tin; after which, it is placed in a mould, corresponding in form and size with the beam required to be produced, and made fast to the bottom of the same with well-tinned pins and nails; then iron, in a fluid state, is poured upon the wrought-iron, until the mould is filled; and, when cold, the wrought-iron and cast-iron will be found to be firmly united.

Steel is united with cast-iron by the same process as wrought-iron. Copper, or gun-metal, or brass, or any other alloy of copper, is united with cast-iron by similar means to the preceding; but, instead of the surface of the copper or alloy being cleaned by acid and alkaline solutions, this is effected by filing; and the iron is added at a lower degree of heat, so that it may not melt the body of the copper or alloy. When compound pieces of metal of a large size are to be produced, the proportion of copper in the solder, before described, must be increased.

In the above description, the different metals are supposed to be united laterally, or side by side; but one metal may have another united to it on both sides, or be enclosed by it on all sides; and the pieces may likewise be of a curvilinear, angular, or other form,—the mode of casting being varied to suit the circumstances of each case.

The patentee claims, as his invention, the uniting of the different metals and alloys of metals, before particularized, by means of the method or methods, and of the interposed alloy or solder before described.—[*Inrolled, January,* 1848.] Ibid.

Specification of a Patent granted to James Napier, *of Shacklewell, in the county of Middlesex, Operative Chemist, for Improvements in smelting Copper Ores.*—[Sealed, July 20, 1846.]

The object of this invention is to facilitate the operation of smelting copper ores, and this the patentee proposes to effect by the application of iron and alkaline substances, and by decomposing and disintegrating the products resulting from such application, by means of water.

If the ores contain less than twenty per cent. of copper, and more than two parts, by weight, of sulphur, to four parts, by weight, of copper, they are first subjected to the ordinary process of calcining and melting, to produce what is termed "coarse metal." If the ores contain less than twenty per cent. of copper and a smaller proportion of sulphur than that above mentioned, other ores, containing sulphur in a larger proportion, must be mixed therewith, in such quantities that the average proportion of sulphur in the mixture will be two parts, by weight, to four parts of copper; and the mixture is then treated in the manner before mentioned for obtaining coarse metal. When the unmixed ores or the mixtures of ores contain more than twenty per cent. of copper, and a greater proportion of sulphur than one part, by weight, to four parts of copper, they are not subjected to the above processes of calcining and melting, but are treated at once in the manner described below for coarse metal.

To each ton of coarse metal. fifty-six pounds of soda-ash, (containing about fifty per cent. of alkali,) and fifty-six pounds of slaked lime are added, and the mixture is put into what smelters term a "metal furnace;" when it is in a state of fusion, any slag that may have formed is skimmed off, and a quantity of scrap-iron is introduced, in the proportion of one hundred-weight thereof to each ton of coarse metal. As soon as this is melted, the whole is well stirred with a rabble, and the furnace being immediately tapped, the fused mass is run into sand moulds. When the contents of the moulds are sufficiently set to be removed, they are put into a shallow pit, containing sufficient water to cover the whole, and allowed to remain therein from two to three hours; by which time the mass will have become partially decomposed and disintegrated. The excess of water is then run off, and the mass removed, and allowed to remain in a heap until the whole is reduced to a fine powder, which will be in about twenty-four hours. The powder is washed in any convenient manner, and introduced into a calcining furnace, in which the heat is gradually increased for twenty hours, so that at the expiration of this time a bright yellow heat will be obtained; and this yellow heat is continued for six hours longer—care being taken to prevent the heat from increasing to such a degree as would cake or fuse the powder, and to stir the powder regularly at intervals during the whole time. The powder is now withdrawn from the calcining furnace, and after being sprinkled with water, according to the ordinary practice, is introduced into a fusing or metal furnace; and for each ton of the powder about one hundred-weight of pulverized anthracite coal and ten pounds of sand are added; a further addition of a quantity of sand or fluor-spar, as a flux, being made if found necessary. As soon as the whole is well fused, the slag is skimmed off, and the furnace tapped into sand moulds. The product thus obtained is generally fit for the refining furnace; but if a small portion of it should be regulus, this regulus, which is rich in copper, is to be roasted, and afterwards refined. The slag, above mentioned, contains copper, and may be employed as a flux in charges for the ore-furnace, as usual.

The patentee states that he does not confine himself to the above details. as the proportions of the ingredients, the mode of adding the iron and alkaline substances, and the stage at which they are added, and likewise the duration of the processes, may be varied. He has found that potash and its carbonates will produce a similar effect to soda and its carbonates; but the former is more costly. He claims the application of iron with alkaline substances to the smelting of copper ores, and the decomposing and disintegrating, by means of water, the products obtained by such application.—[*Inrolled, January,* 1847.]

Ibid.

Specification of a patent granted to James Napier, *of Shacklewell-lane, in the county of Middlesex, Operative Chemist, for improvements in smelting copper and other ores.*—[Sealed, 2nd March, 1847.]

This invention consists in improvements in smelting copper ores, by treating them with fluxes, consisting of common salt, lime, and carbonaceous matters; and also in improvements in smelting ores, containing silver, or gold, or both those metals, by the addition of alkaline substances, coal, iron, and galena.

The first object is to facilitate the separation of the earth from the copper; and to effect this, when several ores of different descriptions are to be operated upon, the patentee mixes them in such proportions, in relation to the earthy matters or gangue they contain, as will cause the earths to unite in the furnace and form glass: the ores have been mixed in suitable proportions, when the silica in the mixture ranges from 50 to 75 per cent., in relation to the other earthy matters, which are generally mixtures of alumina, lime, baryta, fluor-spar, &c.,—the presence of oxide of iron greatly facilitates the fusion of the ores. Should the mixture (or the ore, when only one description of ore is being treated) not contain silica in the above proportion, the deficiency is to be supplied by the addition of sand; or, if the silica exceeds the above proportion, lime or fluor-spar is to be added.

After the above preparatory process, the operation is conducted in the following manner:—If the ore or ores should contain not less than 1 part of iron and 1 part of sulphur, to 2 parts of copper, an addition is made to every ton of the ore, of 56lbs. common salt, 40lbs. of slaked lime, and 100lbs. of coal, and the whole is fused in a melting furnace. When fused, the slag or scoria is skimmed off, and the furnace is tapped into sand moulds: the ingots or pigs, thus produced, are treated as hereafter described. If the ore or ores should contain less than 1 part of iron to 2 parts of copper, the deficiency is to be supplied by the addition of sulphuret of iron; or the ore is to be treated as before mentioned; (omitting the coal;) and after the fused mass has been skimmed, 30lbs. of scrap-iron are to be dispersed over the surface thereof, as equally as possible, and the door of the furnace is closed until the scrap-iron is melted; the furnace is then to be tapped into sand mould. When the ingots, obtained in the above manner, are set, they are thrown into water, whereby they become disintegrated and fall into a fine powder; this powder is thrown into a heap, and allowed to remain for forty-eight hours; after which, it is removed to a calcining furnace, and treated in the manner described in the specification of a patent obtained by the present patentee, July 20, 1846.* The addition of black oxide of manganese, instead of iron, has been found to produce a similar effect, but not with equal advantage.

When ores containing little or no sulphur are operated upon, the above-mentioned processes of disintegration and calcination are omitted. The patentee commences, in this case, by mixing the ores, in relation to their earthy matters, so as to form glass, as above described; (the ores, when containing no iron, might with advantage have a small quantity of oxide or carbonate of iron added;) and then 80lbs. common salt, 50lbs. slaked lime, and 100lbs. anthracite coal, finely pulverized, are added to each ton of ore containing 10 per cent of copper. If the ore should be richer in copper, a smaller proportion of salt and lime will suffice, and a greater proportion of anthracite coal will be required: the patentee says, he has found, that for an ore containing 25 per cent. of copper, 56lbs. common salt, 50lbs. slaked lime, and 150lbs. anthracite coal will answer well. The mixture of ore and other materials is fused in a melting furnace, which, for a charge of 25cwt. of ore, will take from five to six hours; and then the fused mass is tapped into sand moulds: the copper, thus obtained, will generally be ready for the refining operation; but should a portion of the produce be regulus, it is to be roasted, and afterwards refined. Soda and several of its salts may be used instead of common salts; and so likewise may potash and several of its salts, or mixtures of these, free from sulphur.

Sulphuretted ores of copper, containing silver, or gold, or both these metals, are treated in the following manner:—The ore is first calcined and fused, as in the ordinary smelting process, so as to produce a regulus, containing about 50 per cent. of copper; with every ton of this regulus, 56lbs. soda-ash, 40lbs. slaked lime, 1cwt. coal, 1½cwt. iron in scraps, and 4cwts. galena (sulphuret of lead) are mixed, and the mixture is fused in a fusing furnace until the iron disappears; the fused mass is then well rabbled, and tapped into sand moulds. The lead will be found reduced at the bottom of the first and second ingots, and will contain all, or the greater part, of the silver, or gold, or both, which the ore previously contained; these metals are afterwards separated from the lead by the ordinary methods of separating silver and gold from lead. The copper is treated in the ordinary manner, or as described in the specification of the patent before alluded to. Instead of galena, the oxide of lead may be employed; in which case the iron is dispensed with; but the patentee prefers to use galena.

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* For description of this invention, see Vol. XXX, p. 110, of our present series.

When treating ores of silver, or gold, or both, which do not contain copper, or which do not contain it in the state of a sulphuret, the patentee adds copper pyrites thereto, in the proportion of 4cwts. of the latter to 16cwts. of ore, and then proceeds in the manner above described, viz.: bringing the material into a state of regulus, and fusing it with soda-ash, lime, coal, iron, and galena.

In conclusion, the patentee says, that he does not confine himself to the precise details or proportions of the ingredients used, so long as the peculiar character of the invention be retained.—[*Inrolled, September*, 1847.] Ibid.

MECHANICS, PHYSICS, AND CHEMISTRY.

A Description of Col. Long's Composite Bridge. Secured, March 10, 1845, *and Patented, November* 13, 1847.

(Continued from page 207.)

Remarks of the Patentee, Explanatory of the Nature and Character of the Improvements contemplated in the foregoing Specification, and regarded as New, Useful, and Original.

The improvements under consideration, embrace the following specific objects, viz:

1st. The method of trussing or straining a bridge truss frame as set forth in the specification: which method is of such a character and tendency, that the posts or vertical ties, and the suspensor braces may conjointly and reciprocally perform their respective and appropriate offices or operations (in connexion with other parts of the bridge) either by *tension* or draught, or by *thrust* or pushing, as circumstances may require, or as the stresses in or upon the bridge, produced either by trussing or by the passage of loads on the bridge, may have a tendency to produce, reciprocally and alternately, one or the other of these actions, in the posts and braces.

2nd. The manner of introducing and using the posts or vertical ties as described in the foregoing specification, especially the manner of attaching the same to the upper and lower strings of a bridge truss frame, and in connexion with the posts or vertical ties thereof.

3rd. The manner of introducing and using the main thrust braces, in connexion with movable bolsters, or gluts, as set forth in said specification.

4th. The application and use of movable bolsters, and of movable gluts, at the extremities of, and in connexion with, the main thrust braces, as set forth in said specification.

5th. The introduction and use of keys or wedges, between the posts and the bolsters or gluts, for the purpose of forcing the ends of the main thrust braces, together with the bolsters or gluts, connected therewith, to pass or slide along the strings, whereby the trussing of the bridge is effected in a manner different from any heretofore adopted.

6th. The application and use of extra braces for the purpose of strengthening and otherwise fortifying the truss frame;—these parts being regarded as highly useful, and beneficial.

7th. The composite bridge as distinguished from all other bridges, by the introduction and use of the several improvements, modifications, and combinations, individually and collectively applied, as set forth and described in the foregoing specification, and more particularly designated in the foregoing remarks, is claimed as a new and useful invention. The application and employment of said improvements, modifications, and combinations, individually and collectively, in the construction of bridge truss frames generally, and of other truss frame work, whether of timber, or of other materials, is also claimed as a new and useful invention.

In regard to the trussing or straining of the bridge, as contemplated in the 1st remark, as above, it should be distinctly understood, that this, as a principle in bridge architecture, was discovered by me in 1828, and patented in 1830.

Its object was, to secure and maintain vertical stiffness or inflexibility in bridges, and to afford the means of reclaiming or straightening, and recambering the spans, of a bridge, in the event of their having sagged or subsided in the parts intermediate to its abutments and piers. The discovery and adaptation of this principle, in so far as it relates to bridge building, is exclusively my own invention.

In the composite bridge, I claim the introduction and use of this same principle, by means of certain new modifications and arrangements in the constituent parts of the truss frames, constituting specific differences, in the manner of applying the principle in question, to structures of this sort, all of which differences have been clearly explained in my specification, and will be at once manifest on a comparison of the drawings and model of said bridge, with those of my former bridges, now in the patent office.

The introduction of this principle is effected by means of sundry new arrangements or modifications, already adverted to, and is attended by divers new combinations, in the stresses or actions of several parts of the truss frame, never before exemplified, as I shall now endeavor to show.

With respect to the reciprocal actions of *thrust*, push or compression, and of *tension*, draft or stretching, in the posts and main suspensor braces, as produced by peculiarities in the construction of the composite bridge, a few explanations are deemed appropriate. These actions are such, that when the former (thrust) takes effect in the posts, the latter (tension) takes effect in the brace, and *vice versa*, when the former takes effect on the brace, the latter takes effect on the post. These actions may be produced either by the passage of a load across the bridge, or by increasing and relaxing the strain imparted by the main thrust braces. No such reciprocal results have ever been or can be produced in the posts and suspensor braces, by any arrangement of their parts heretofore adopted. Similar results might be produced by causing the ends of the main thrust braces to slide along the posts by means of gluts or bolsters, with wedges driven between the latter and the strings; but, as remarked on a former occasion, the force required to produce the effect by this arrangement, compared with that required to produce the same effect in the composite bridge, will be far greater, while at the same time its application would obviously be more difficult and less convenient in all respects, in the former than in the latter case.

In my suspension bridge, patented in 1839, the main suspensor braces, as also the counter suspensor braces, operate by *tension* only, and the posts by *thrust* only, nor can they impart their efficiency in giving strength to the truss frame, in any other way. In my brace bridge, patented in the same year, the main braces act by thrust only, and the posts by tension only, nor can they strengthen the truss frame in any other way. In my composite bridge, the posts and main suspensor braces are so arranged and adjusted in connexion with the other parts of the truss frame, that both of these parts can, and do, act either by tension, or by thrust, according to circumstances. Some of the circumstances here alluded to as effecting these actions, are as follows, viz :—

1st. When the truss frame is lax, untrussed, or unstrained, by the action of the main thrust braces, or in other words, before the wedges are driven between the bolsters or gluts, and posts, the main suspensor braces will act by tension, and the posts will act by thrust, with or without a load on the bridge.

2nd. When the truss frame is trussed, or strained, by the action of the main thrust braces, or in other words, when the truss wedges have been firmly driven between the bolsters, or gluts, and the posts, the main suspensor braces will act by thrust, and the posts by tension.

3rd. When the truss frame has been trussed, or strained, as in the preceding paragraph, and a load is placed on the bridge, sufficiently heavy to counteract and overcome the action of the main thrust braces after they have been strained, as before mentioned, the main suspensor braces will again act by tension, and the posts by thrust.

4th. The bridge being loaded, as in the preceding paragraph, and the truss wedges being driven again more forcibly between the bolsters, or gluts, and the posts;—the main suspensor braces will again be brought into action by thrust, and the posts by tension.

To the understanding of the machinist, these results are sufficiently obvious, without mathematical demonstration.

Thus has it been shown that all the claims, from the 1st to the 5th inclusive, relate to co-operative principles, or actions taking effect, or rendered efficient in the composite bridge: and that these several principles may operate conjointly, as well as separately, in imparting strength and efficiency to the structure.

I shall now attempt to show how the extra braces perform their part in "strengthening and otherwise fortifying the truss frame."

These braces rise from the lower strings within an abutment, or pier panel, and terminate at the upper strings, within the next adjacent panel;—and from the lower string, at the insertion of a suspensor brace, to the upper string at the insertion of the suspensor brace for the next adjacent panel, counting from the abutment, or pier, and so on for the other panels.

The extra brace first mentioned, imparts its efficiency, in aid of sustaining the bridge, and its load, at the pier, or abutment. Its efficient action is ensured, not only by the resting of the upper string on its head, but by its attachment to the head of the main suspensor brace, by trenails. All other extra braces perform their offices by means of attachments, or connexions, similar to that last mentioned, both at the head, and at the foot, of the main suspensor braces. By means of their connexion with these braces, and with the strings, the extra braces last mentioned, operate by stresses similar to those to which the posts are subjected: that is to say, when the posts act by *thrust*, the extra braces will act by thrust, and whenever the posts act by *tension*, the extra braces will act by tension; thus relieving the posts and their fastenings from an amount of action, which might otherwise prove greater than they are able to bear.

The extra braces contribute also to impart lateral stiffness to the posts, which may be needful, in the event of extraordinary thrust or compression in the latter.

Moreover, on driving the truss wedges or keys, the bolsters or gluts connected with them are removed farther from the ends of the posts, and of course, the points, at which the thrust of the main thrust braces is received upon the strings, are at the same time removed farther from the posts. Hence the thrust of the main thrust brace, will have a tendency to spring or force outward the string on one side of the post, while the tendency or counter strains on the other side of the post will be inward, and in consequence will be met, counterpoised, and resisted by the extra brace.

Hence, although the extra braces may not be regarded as essential, they cannot be viewed in any other light than that of subserving the purposes for which they are intended, viz: "of strengthening and otherwise fortifying the bridge."

Thus has it been shown that all the improvements and modifications claimed by me as new and original, are individually embraced and collectively co-operative in the composite bridge, and are all instrumental in imparting strength, efficiency, and inflexibility, to the bridge, in a way never before adopted in bridge building. The 7th remark has been added for the purpose of showing that I possess the right of employing these several improvements individually, or collectively, in bridge building, and in all other structures, whether of wood, iron, or other materials, in which truss frames are deemed appropriate, as component parts of the work.

Directions to Builders of the Composite Bridge.

Under this head there remains very little to be added to what has already been advanced in a former part of this treatise, in relation to the construction of the brace and suspension bridges, the parts, dimensions, and proportions of one or the other of which, are similar in most respects to those of the composite bridge. The following parts, however, may be regarded as peculiar to the bridge last mentioned, and of course are entitled to particular notice.

I.—*Of the Posts or Vertical Ties.*

These parts may have the same transverse dimensions as other parts of the truss frame, and should be of such length as to extend outward about nine inches beyond the strings, both upward and downward. The ends of the posts above and below the strings, should be scarfed in a manner to be in close contact with the ends of the suspensor braces. The posts are inserted in the spaces situated between the string pieces, and are firmly connected thereto by trenails, as represented in the drawings.

II.—*Of the Main Thrust Braces.*

These braces differ from those of the brace bridge in the number of pieces of which they are respectively composed, each brace containing one piece more in the composite than in the brace bridge. Moreover, instead of abutting against shoulders in the posts, as in the latter, they abut against movable bolsters; or in cases where gluts are used instead of bolsters, these braces abut partly against the strings, and by means of the gluts, partly against the posts.

The main thrust braces, together with their bolsters or gluts, &c., may be prepared and fitted, whilst the framing of the bridge is in progress, but need not be inserted in the bridge till its ribs, or truss frames, shall have been put up at the bridge site.

The ends of the main thrust braces may be confined to the bolsters by means of spikes or nails, should such fastenings be deemed proper; —but when these braces are used in connexion with gluts, they will be sufficiently bonded by the trenails employed on such occasions.

III.—*Of the Brace Bolsters.*

These parts should be made of well seasoned oak, or other hard timber, dressed to the size of about six by eight inches, and cut into lengths exceeding the entire width of the string by about three inches, one of the broader sides of the bolster is applied to the strings, and one of the narrower sides to the posts, in alternate angles of each panel. The inner angle is terminated in such a manner as to present a surface about nine inches wide, and at right angles to the main thrust brace, against which the latter abuts. Each bolster should be furnished with recesses, made in its back, for the admission of the brace keys, or wedges, the slope or taper of the recesses, and of the keys, being about in the ratio of 1 to 12. The number of the recesses in each bolster, as also the number of the keys, should be the same as the number of pieces of which the post is composed. The slopes of the recesses should be a little more abrupt than those of the keys, in order to ensure a stress somewhat greater at the base, than at the top or opposite side of the bolster; whereby the driving of the keys will have a tendency to keep the oblique face of the bolster perpendicular to the brace.

IV.—*Of the Gluts, &c.*

The form and dimensions of these parts, and the positions of the trenails, by which they are confined in their places, as also the forms and positions of the brace keys connected therewith, are represented with sufficient clearness in the drawings. The timber of which they are composed is similar to that of other parts of the truss frame.

V.—*Of the Brace Keys, or Wedges.*

These parts should be constructed of well seasoned oak, locust, or other unyielding and durable timber. Their length should be two to three feet, their thickness equal to that of a post or suspensor brace timber, and their slope, as before stated, about in the ratio of 1 to 12. They may be applied in such a manner, as that they may be driven either upward or downward, as may be found most convenient.

VI.—*Of the Trenails.*

Among the various parts of the composite bridge, none requires greater care and precision in their adjustment, than the numerous trenails required in its construction. They should be made of straight-grained, tough, and well seasoned oak, locust or other hard and durable timber, and should be of a size and form, adapted with precision to the holes made for their reception. The number of the trenails, at the several places where they are required, should be as represented in the drawings, viz: six, at every intersection of a string and main suspensor brace; four or six at every intersection of a string and post; four at each glut; two at every intersection of an extra brace and suspensor brace; and ten at every splice of the string pieces;—besides which screw bolts of ¾ inch iron should be applied, as clamps, at the following points, viz: one at every intersection of a main suspensor, and a main thrust brace; one at every intersection of a post and extra brace; and four at or near the angles or corners of each outside splicing piece.

The size of the trenails should correspond in some degree, with the transverse dimensions of the timbers through which they are to pass. When the transverse dimensions of the timbers are 1½ by 8 inches, the diameter of the trenails should be about one inch. Timbers 2 by 10 inches, require trenails about 1¼ inch in diameter;—3 by 12 inches, 1½ inch in diameter;—3 by 14 inches, 1¾ inch in diameter; —4 by 14 inches, 2 inches in diameter. The lengths of the trenails should be such, that both ends respectively, may protrude about half an inch beyond the timbers through which they are driven.

The method of preparing bridge trenails, suggested in a former part of this treatise, has been found objectionable, for the following reasons. The successive impacts of the mallet, applied for the purpose of driving the trenails through the cutter, cannot all be given precisely in the same direction. Hence, it results, that the trenail, besides being crooked, is more or less ribbed at the extremity of each movement, communicated respectively by the impacts. In consequence both of the ribs and crooks thus produced, the facility of driving the trenails into the timbers of the bridge, as also their efficiency when driven, are much impaired.

Moreover, the process of driving the trenail through the cutter, is often attended by the production of spalls, splits, or exfoliations from the body of the trenail, whereby its sides are frequently rendered lean and defective, and its bearings and efficiency greatly impaired.

These evils may be effectually remedied, by forming the trenails in a slide lathe, properly adjusted for this purpose. By this means, trenails may be made of uniform sizes, and with straight, smooth, and equable surfaces, adapted in all respects to the holes in which they are to be inserted. Their appropriate lengths being previously determined, their extremities may be rounded into a hemispherical form, whereby their appearance when applied to the bridge, may be rendered, in no small degree, ornamental.

With respect to the holes perforated for the reception of the trenails, they should be formed by the use of augers of the best kind, or furnished with cutters so adjusted, as to render the holes when bored, perfectly round, straight, and smooth, on all sides. The trenails should snugly and completely fill the holes, and should never be so large as to impart a lateral or splitting strain to the timbers in which they are inserted.

Finally, the lateral and transverse bearings, the side arch bracings, the inferior arch bracings, the flooring, the roofing and sheathing, the splicings of the strings, the bolsters and bolster frames, the trustle piers, &c., &c., in so far as they relate to the composite bridge, are to be constructed and applied in the manner prescribed under the head of "directions to bridge builders" in the former part of this treatise.

Mistakes of a serious nature having occurred in a few instances, in consequence of inserting the splicing of the strings in immediate connexion with the posts, it is proper on this occasion to caution the bridge builder against the commission of any similar mistake, in his future operations. The splicing of the strings should always be located about midway of the panel, so that the spliced string pieces may abut at equal distances from the posts, by which the vertical sides of the panel are bounded. For it is manifest, that when the splicings occur at the posts, no splicing pieces can be inserted between the parts of the string, and consequently that the strength and efficiency of the string will be seriously impaired. The points at which the string pieces abut, should be located midway between the posts of the panel.

Objections to the Theories severally of Franklin, Dufay, and Ampere, with an effort to explain Electrical Phenomena, by Statical, or Undulatory, Polarization. *By* ROBERT HARE, M. D., *Emeritus Professor of Chemistry in the University of Pennsylvania.*

(Continued from page 199.)

The extreme diversity, as respects striking distance, between the direct effects of Frictional Electricity and those directly arising from Galvanic Reaction.

46. The intensity of the excitement produced by different electri-

cal machines, is estimated to be as the relative lengths of the sparks which proceed from their prime conductors respectively. Admitting that the relative intensity were merely as the length of the spark, not as the square of that length, still there would be an infinite difference between the intensity of a voltaic series and that of electrical machines, if measured by this test. Large electrical machines, like that at the Polytechnic Institution, London, give sparks at twenty inches and more; while agreeably to Gassiot's experiments, a Groves battery of 320 pairs, in full power, would not, before contact, give a spark at *any distance, however minute.* It follows, that, as respects the species of intensity which is indicated by length of sparks, or striking distance, the difference between the electricity of the most powerful voltaic series and electrical machines, is not to be represented by any degree of *disparity;* it proves that galvanism proper and electricity proper are heterogeneous.

47. It should be recollected that the intensity of galvanic action, in a series of 320 pairs, excepting the loss from conduction, would be to that of one pair as 320 to 1.* Of course, the striking distance of a battery of one pair would be 320 times less than nothing: 320 below zero.

48. We may infer that the undulatory polarization of ethereo-ponderable matter, is the primary, direct, and characteristic, effect of galvanic excitement, in its more energetic modifications. Yet, that by peculiar care in securing insulation, as in the water batteries of Crosse and Gassiott, ethereal undulations may be produced, with the consequent accumulation of ethereal polarity requisite to give sparks before contact, agreeably to the experiments of those ingenious philosophers.

49. Hence it may be presumed, that during intense ethereo-ponderable polarization, superficial ethereal waves may always be a collateral effect, although the conducting power of the reagents, requisite to the constitution of powerful galvanic batteries, is inconsistent with that accumulation of ethereal polarity which constitutes a statical spark-giving charge.

50. As all the members forming a voltaic series have to be discharged in one circuit, the energy of the effort to discharge, and the velocity of the consequent undulations must be, ceteris paribus, as the number of members which co-operate to produce the discharge. Of

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* According to Colomb's experiments, electrical attraction and repulsion are inversely as the squares of the distances, and the inductive power of statical charges which is produced by those forces, and which precedes and determines the length of the resulting spark, must, of course, obey the same law.

If this calculation be correct, the intensity must be as the squares of the striking distances, as indicated by sparks.

It may be urged, that the striking distances, as measured by the length of the sparks, is in the compound ratio of the quantity and intensity. As to the quantity, however, galvanic sources have always been treated as pre-eminent in efficacy, so that on that side there could be no disparity. Moreover, I have found, that in galvanic apparatus of only one, or even of two pairs, as in the calorimotors, the intensity lessened as the surfaces were enlarged. By a pair of fifty square feet, of zinc surface, a white heat could not be produced in a wire of any size, however small. The calorific power of such apparatus can only be made evident by the production of a comparatively very low temperature, in a comparatively very large mass.

course the more active the ethereo-ponderable waves, the greater must be their efficacy in producing ethereal waves of polarization, as a secondary effect, agreeably to the suggestions above made. (49, 36.)

51. Hence in a battery consisting of one galvanic pair excited by reagents of great chemical energy, and conducting power, the electro-magnetic effects are pre-eminent; while De Luc's electric columns consisting of several thousands of minute pairs, feeble as to their chemical and conducting efficacy, are pre-eminent for statical spark-giving power. (48.) This seems to be quite consistent; since on the one hand, the waves of polarization must be larger and slower, as the pairs are bigger and fewer; and on the other hand smaller and more active, as the pairs are more minute and more numerous.

On the perfect similitude between the Polarity communicated to Iron Filings by a Magnetized Steel Bar, and a Galvanized Wire.

52. If by a sieve, or any other means, iron filings be duly strewed over a paper, resting on a bar magnet, they will all become magnets, so as to arrange themselves in rows like the links of a chain. Each of the little magnets thus created, will, at its outermost end, have a polarity similar to that of the pole (of the magnet) with which it may be affiliated. Of course the resulting ferruginous rows, formed severally by the two different poles of the bar, will have polarities as opposite as those of the said poles.

53. In an analogous mode, if two wires be made the media of a galvanic discharge, iron filings, under their influence, will receive a magnetic polarity, arranging themselves about each wire like so many tangents to as many radii proceeding from its axis. Those magnetized by one wire reacting with such as are magnetized by the other.

54. The affections of the ferruginous particles during the continuance of the current so called, are precisely like those of the same particles when under the influence of the bar magnet. The great discordancy is in the fact, that the influence of the magnet is permanent, while that of the wire is indebted for existence to a series of oppositely polarizing but transient impulses which proceed towards the middle of the circuit from each side, so as to produce reciprocal neutralization by meeting midway.

55. The effect upon the filings, as originally pointed out by Oersted, is precisely such as would arise were the ponderable matter of the wire resolved by each impulse into innumerable little magnets, situated so as to form tangents to as many radii proceeding from the axis of the wire.

56. Independently of the filings, the wires react with each other as if their constitution, during subjection to the discharge, were such as above supposed. When the discharges through them concur in direction, they attract, because the left side of one is next the right side of the other, bringing the opposite poles of their little magnets into proximity; but when the discharge is made in opposite directions, the two right or the two left sides will be in proximity, and will, by the

consequent approximation of the similar poles of the little magnets, be productive of repulsion.

57. From these last mentioned facts and considerations, it must be evident that, assuming that there is in a galvanized wire a derangement of the poles of the constituent ethereo-ponderable particles analogous to that permanently existing in magnetized steel, involves no contradiction, no absurdity, nor any thing but what is consistent with the researches and inferences of Davy, Faraday, and other eminent investigators of the phenomena of nature.

Process by which the Ethereo-ponderable Atoms within a Galvanic Circuit are Polarized by the Chemical Reaction.

58. In order that an ethereo-ponderable particle of oxygen in any aqueous solution shall unite with an ethereo-ponderable particle of zinc in a galvanic pair, there must be a partial revolution of the whole row of ethereo-ponderable zinc atoms, with which the atom assailed is catenated by the attractions between dissimilar poles. Moreover, at the same time that the metallic atoms are thus affected, the atoms of water between the metallic surfaces must undergo a similar movement, by an analogous reaction with poles of an opposite character, and this movement must extend through the negative plate to the conductor, by which it communicates with the zinc or electro-positive plate. When the circuit is open, the power of combination exercised by the zinc and oxygen is inadequate to produce this movement in the whole chain of atoms, liquid and metallic; but as it is indifferent whether any two atoms are united with each other, or with any other atoms of the same kind, the chemical force easily causes them to exchange partners, as it were, when the whole are made to form a circuitous row in due contiguity.

59. As we know that during their union with oxygen, metals give out an enormous quantity of heat and electricity, it is reasonable to suppose that whenever an atom of oxygen and an atom of zinc jump into union with each other, a wave is induced in the ethereo-ponderable matter, and that this wave is sustained by the decompositions and recompositions by means of which an atom of hydrogen is evolved at the negative plate, and probably enabled to assume the aëriform state. There must, at the same time, be a communication of wave polarity by contact of the negative plate with the connecting wire, by which the positive wave in the wire is induced. Although the inherent polarities of the metals are not, agreeably to this view, the moving power in galvanism, yet they facilitate, and in some cases induce the exercise of that power, by enabling it to act at a distance, when otherwise it might remain inert.

60. This, I conceive, is shown in the effect of platina sponge upon a mixture of the gaseous elements of water; also in Groves' *gas* battery, by means of which hydrogen and oxygen gas severally react with water in syphons, so as to cause each other to condense, without any communication besides that through the platina, and an electrolytic decomposition and recomposition extending from one of the

aqueous surfaces in contact with one of the gases, to the other surface in contact with the other gas.

Difference between Electro-ethereal and Ethereo-ponderable Polarization.

61. There are two species of electro-polarity which come under the head of statical electricity. One of these Faraday illustrates by supposing three bodies, A, B, and C, in proximity. but not in contact, when A, being electrified, electrifies B, and B electrifies C by induction. This Faraday calls an *action* of the particles of the bodies concerned, whereas, by his own premises, it appears to me to be merely a superficial affection of the masses or of a circumambient ethereal matter. This species of polarization, to which the insulating power of air is necessary, affects the superficies of a body only, being displayed as well by a gilt globe of glass, as a solid globe of metal. No sensible change appears to be produced in the ponderable conducting superficies by this inductive superficial electrification of masses; and of course no magnetism.

62. When a small image, of which the scalp has been abundantly furnished with long hair, is electrified, the hairy filaments extend themselves and move apart, as if actuated by a repulsive power, also when iron filings are so managed as to obey the influence of the poles of a powerful magnet, (51,) they arrange themselves in a manner resembling that of the electrified hair. There is, moreover, this additional analogy, that there is an attraction between two portions of hair differently electrified, like that which arises between filings differently magnetized. Yet the properties of the electrified hair and magnetized filings are, in some respects, utterly dissimilar. A conducting communication between differently electrified portions of hair would entirely neutralize the respective electrical states; so that all the electrical phenomena displayed by them would cease. Yet such a communication made between the poles, exciting the filings, by any non-magnetic conductor, does not in the slightest degree lessen their polar affections and consequent power of reciprocal influence. Upon the electrified hair, the proximity or the contact of a steel magnet has no more effect than would result under like circumstances from any other metallic mass similarly employed; but by the approximation, and still more, the contact, of such a magnet, the affection of the filings may be enhanced, lessened, or nullified, according to the mode of its employment. In the case of the hair, the affection is superficial, and the requisite charging power must be in proportion to the extent of surface. In the case of the magnetized ferruginous particles, it is the mass which is affected, and, ceteris paribus, the more metal, the greater the capacity for magnetic power. In the instance of the electrified hair, as in every other of frictional excitement, the electrical power resides in imponderable ethereo-electric atmospheres which adhere superficially to the masses, being liable to be unequally distributed upon them in opposite states of polarity, consequent to a superficial polarization of the exciting or excited ponderable masses; but in the instance of bodies permanently magnetic, or those rendered tran-

siently magnetic by galvanic influence, the ethereo-electric matter and the ponderable atoms are inferred to be in a state of combination, forming ethereo-ponderable atoms; so that both may become parties to the movements and affections of which the positive and negative waves consist.

63. Thus an explanation is afforded of the hitherto mysterious diversity of the powers of a gold leaf electroscope and galvanoscopes, although both are in a miraculous degree sensitive; the latter to the most feeble galvanic discharge, the former to the slightest statical excitement; yet neither is in the most minute degree affected by the polarization which affects the other.

64. The charge which may exist in a coated pane affords another exemplification of statical or electro-ethereal polarity. In this case, according to Faraday, the particles of glass are thrown into a state of electro-polarity, and are, in fact, partially affected as if they belonged to a conductor; so that insulators and conductors differ only in the possession in a high degree by the one, of a susceptibility of which the other is possessed to an extent barely perceptible. The facts seem to me only to show, that either an insulator or conductor may be affected by the same polarizing force, the transmission of which the one facilitates, the other prevents. I am under the impression that it is only by the disruptive process that electricity passes through glass; of course involving a fracture. It gets through a pane or jar, not by aid of the vitreous particles, but in despite of their opposing coherence. The glass in such cases is not liable to be fused, deflagrated, or dissipated, as conductors are. It is forced out of the way of the electrical waves, being incapable of becoming a party to them. Discharges will take place through a vacuity, rather than through the thinnest leaf of mica. But if, as Faraday has alleged, from within a glass flask hermetically sealed, an electrical charge has been found to escape, after a long time, it proves only that glass is not a perfect insulator, *not that perfect insulation and perfect conduction are different extremes of the same property.* On the contrary, the one is founded upon a constitution competent to the propagation within it of the electro-polarizing waves, with miraculous facility, while the other is founded either on an absolute incapacity, or comparatively an infinitely small ability, to be the medium of their conveyance. The one extremely retards, the other excessively expedites, its passage through a space otherwise void.*

Competency of a Wire to convey a Galvanic Discharge is as its sectional area, while statical discharges of frictional electricity preferring the surface are promoted by its extension. Yet in proportion as such discharges are heavy, the ability of a wire to convey them and its magnetic energy become more dependent on its sectional area and less upon extent of surface.

65. Reference has been made to two modes of electrical conduction,

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* By a void, I mean a Torricellian vacuum. The omnipresence of the electro-ether must render the existence of a perfect void impossible.

in one of which the efficacy is as the surface; in the other, as the area of a section of the conductor. Although glass be substantially a non-conductor, the power of the surface of glass when moistened, or gilt, to discharge statical electricity, is enormous. It has been generally considered, that as a protection against lightning, the same weight of metal employed as a pipe, would be more efficacious than in the usual solid form of a lightning rod: yet this law does not hold good with respect to galvanic discharges, which are not expedited by a mere extension of conducting surface. Independently of the augmentation of conducting power, consequent to radiation and contact with the air, the cooling influence of which, according to Davy, promotes galvano-electric conduction, a metallic ribbon does not convey a galvanic discharge better than a wire of similar weight and length.*

66. Agreeably to the considerations above stated, the sectional area of a conductor remaining the same, in proportion as any *statical* accumulation which it may discharge is greater, the effects are less superficial; and the ethereo-ponderable atoms are affected more analogously to those exposed to galvanic discharges. It is in this way that the discharge of a Leyden jar imparts magnetic polarization. Thus, on the one hand, the electro-ethereal matter being polarized and greatly condensed, combines with and communicates polarization, and consequently magnetism, to ethereo-ponderable bodies; while on the other hand, these, when polarized by galvanic reaction, and thus rendered magnetic, communicate polarity to the electro-ether. Hence statical electricity, when produced by galvanism, and magnetism, when produced by statical electricity, are secondary effects.

67. Where a wire is of such dimensions, in proportion to the charge, as to be heated, ignited, or dispersed by statical electricity, there seems to be a transitory concentration of the electric power, which transforms the nature of the reaction, and an internal wave of ethereo-ponderable polarization, similar to those of galvano-electricity, is the consequence.

68. As above observed, (31,) the current produced by the magneto-electric machine, has all the attributes of a galvano-electric current: yet this is altogether a secondary effect of the changes of polarity in a keeper, acting upon a wire solely by dynamic induction. But if, by mere external influence, the machine above mentioned can produce within a circuit a current such as above described, is it unreasonable to suppose that the common machine, when it acts upon a circuit, may put into activity the matter existing therein, so as to produce

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* It is well known that Wollaston effected the decomposition of water by the aid of a powerful electrical machine. Having enclosed platina wires within glass tubes, these were fused so as to cover the ends. The glass was afterwards so far removed, by grinding, as to expose minute metallic points to the liquid. Under these circumstances, the electricity conveyed by the wires, being prevented from proceeding over them superficially, was obliged to make its way through the ethereo-ponderable matter of which metals consist. (38.) Instead of proving the identity of galvanism with frictional electricity, (note 39,) this experiment shows that in one characteristic at least there is a discordancy. At the same time it may indicate that ethereal may give rise to ethereo-ponderable undulations.

waves of polarization, having the power of those usually ascribed to a galvano-electrical current?

69. It has been shown that both reason, and the researches and suggestions of Faraday, warrant the inference, that ponderable atoms, in solids and liquids, may be considered as swimming in an enormous quantity of condensed imponderable matter, in which all the particles, whether ponderable or imponderable, are, in their natural state, held in a certain relative position due to the reciprocal attraction of their dissimilar poles. A galvano-electrified body differs from one in its ordinary state, in having the relative position of the poles of its ethereo-ponderable atoms, so changed, that their inherent opposite polarities not being productive of reciprocal neutralization, a reaction with external bodies ensues.

70. In statical excitement the affection is superficial as respects the ponderable bodies concerned, while in dynamic excitement the polarities of the whole mass are deranged oppositely at the different ends of the electrified mass; so that the oppositely disturbing impulses, proceeding from the poles of the disturbing apparatus, neutralize each other intermediately. Supposing the ponderable as well as the imponderable matter in a perfect conductor, to be susceptible of the polar derangement, of which an electrified state is thus represented to consist, non-conductors to be insusceptible of such polar derangement; imperfect conductors may have a constitution intermediate between metals and electrics. When an electrical discharge is made through any space devoid of air or other matter, it must then find its way solely by the polarization of the rare imponderable matter existing therein; and consequently its corruscations should be proportionably more diffuse, which is actually found to be true; but when gaseous ethereo-ponderable atoms intervene, they enable competent waves to exist within a narrower channel, and to attain a greater intensity. I consider all bodies as insulators which cause discharges through them to be more difficult than through a vacuum, and which, by their interposition within a circuit, can prevent that propagation of the oppositely polarizing undulations which would otherwise ensue. This furnishes a good mean of discrimination between insulators and conductors, the criterion being, that a discharge ensues more readily as there is more of the one and less of the other in the way: that the one leads the waves where they would not go, the other impedes their going where they would proceed. Both in the case of diruptive discharge through air, producing a spark, or of a deflagrating discharge through wire, causing its explosion, there is a dispersion of intervening ponderable particles: and yet there is this manifest discordancy, that in one case the undulatory process of transfer is assisted, in the other resisted. The waves follow the metallic filament with intense attraction, while they strive to get out of the way of those formed by the aëriform matter, as if repelled. Hence the term diruprive, from *dirumpo*, to break through, was happily employed by Faraday to designate spark discharges. The zigzag form of the diruptive spark, shows that there is a tendency in the aëriform particles to turn the waves out of that straight course, which, if unresisted or facilitated, they would natu-

rally pursue. On the one hand the aërial filaments being unsuitable for the conveyance of the electric waves, these are forced by them out of the normal path, first in one direction, then in another; while on the other hand, the finest metallic filament furnishes a channel for the electric waves, so favorable that this channel is pursued, although the consequent polarization of the conducting particles be so intense as to make them fly asunder with explosive violence. Even when a bell wire has been dissipated by lightning, it has been found to facilitate and determine the path of the discharge.

71. The various forms of the electric spark, resulting from varying the gas through which it may be made to pass, agreeably to the researches of Faraday, are explained by the supposition that the peculiarities of the spark are partially the consequence of the polarizability of the gaseous atoms through which the discharge is made, and vary accordingly in their appearance.

Difference between Frictional Electricity and Galvanic, does not depend on the one being superior as to quantity, the other as to intensity; but on the different degrees in which the Ethereo-ponderable Atoms of the bodies affected, are deranged from their natural state of Neutralized Polarity.

72. I infer that all magneto-polar charges are attended by an affection of ponderable particles; and that the reason why the most intense statical charge does not affect a galvanometer, is, that it is only when oppositely excited bodies are neutralized by the interposition of a conductor, as during a discharge, that ethereo-ponderable particles are sufficiently polarized to enable them to act upon others in their vicinity, so as to produce a polar affection the opposite of their own. In this way dynamic induction is consistently explained, by supposing that the waves of polarization, in passing along one conductor, produce, pari passu, the opposite polarization in the proximate part of any neighboring conductor suitably constituted, situated and arranged to allow it to form a part of a circuit.

73. It is only during the state of the incessant generation and destruction of what has been called the two electricities, that the circuit, which is the channel for the passage of the polarizing waves, is endowed with electro-magnetic powers. It was, no doubt, in obedience to a perception of this fact, that Oersted ascribed the magnetism of a galvanized wire to a conflict of the electricities. Undoubtedly that state of a conductor in which, by being a part of an electrical circuit, it becomes enabled to display electro-magnetic powers, is so far a conflict of the two electricities, as the affections of matter, which are denominated electrical, consist of two opposite polar forces, proceeding, agreeably to the language of Faraday, in opposite directions from each side of the source, and conflicting with each other so as to be productive of reciprocal annihilation.

74. That a corpuscular change in conductors is concomitant with their subjection to, or emancipation from, a galvanic current, is proved by an experiment of Henry's, which he afforded me an opportunity,

on one occasion, of witnessing. I allude to the fact that sound is produced whenever the circuit is suddenly made or suddenly ruptured.

By I. P. Mairrau it has been observed, that a similar result takes place during the magnetization of iron rods, by the alternate establishment or arrestation of galvanic discharges through wires coiled about them so as to convert each into an electro-magnet. Mr. Mairran represents the sound as resembling that produced by striking a rod upon one of its ends.* † Sounds from this source were observed by Dr. Page in 1838. See Silliman's Journal for that year, Vol. 33.

75. Thus it appears that there is an analogy between the state of matter which involves permanent magnetism, and that which constitutes a galvanic current, so far as this; that either by one or the other, during either its access or cessation, an affection of the ponderable particles concerned ensues, sufficient to produce sound.

76. Simultaneously with the production of sounds as above stated, by the opening or closing of the galvanic circuit through a metallic rod or the coils of an electro-magnet, secondary waves are induced, called secondary currents. It seems reasonable to ascribe these waves to the same shifting of the poles, which produces the sonorific undulations.‡

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* Agreeably to recent experiments of Faraday, the particles of a glass prism may be so influenced by an electro-magnet as to affect the passage of polarized light.

† L. and E. Phil. Mag. and Jour., Vol. 45, p. 383, 1844.

‡ These phenomena excite more interest in consequence of the employment, for medical purposes, of an apparatus originally contrived by Callan, but since ingeniously modified by our countryman, Dr. Page, into a form which has been designated as the electrotome. A coil of coarse copper wire, covered with cotton, like bonnet wire, is wound about a wooden cylinder. Around the coil thus formed, a coil of fine copper wire similarly covered is wound, leaving the extremities accessible. One end of the coarse coil communicating constantly with one pole of a galvanic battery, the other end is left free; so that by scraping with it, the teeth of a rasp attached to the other pole, a rapid closing and opening of the circuit may be effected. Under these circumstances, an observer, holding the ends of the fine coil, receives shocks more or less severe, according to the construction of the battery, the energy of the agents employed to excite it, or the total weight and relative dimensions of the coils, as to length and sectional area. Agreeably to the received doctrine, the shocks thus produced, are owing to secondary currents caused by dynamic induction. Agreeably to the hypothesis, which I have advanced, the atoms of the coarse wire, polarized by waves proceeding from the poles of the battery, induce a corresponding polarization of the atoms of the fine wire; the aggregate polarity imparted, being as the number of atoms in the former to the number of atoms in the latter: or, (to use an equivalent ratio,) as the weight of the coarse, to the weight of the fine wire. But as on breaking the circuit, through the coarse wire, the ethereo-ponderable atoms in both wires resume their neutral positions, while this requires each circuit to be run through within the same minute interval, the velocities of their respective waves will be inversely as their sectional areas and directly as their lengths: in other words, the velocity in the fine wire will be as much greater, as the channel which it affords is narrower and longer. The cylinder, included within the coils as above stated, being removed, a cylindrical space is vacated. If into the cavity thus made, iron rods, like knitting needles, be introduced, one after the other, while the apparatus is in operation, the shocks increase in severity as the number of needles introduced augments; so that from being supportable they may be rendered intolerable. The shock takes place without the presence of iron, but is much increased by its assistance.*

* Agreeably to the usual construction, the cylinder about which the inner coarse wire coil is wound is originally of iron, so that there is as much of this metal contained as it can hold. Various contrivances are resorted to for the closing and opening of the circuit, which are more ingenious and convenient than scraping a rasp, as above described. 24*

77. Within the bodies of animals and vegetables, the electro-ether may be supposed to exist as an atmosphere surrounding the ethereo-ponderable atoms of which their organs are constituted, so as to occupy all the space which is not replete with such atoms. Hence a discharge of frictional electricity may indirectly polarize the whole animal frame, by producing ethereo-ponderable polarization in the constituent atoms of the fibres of the nerves and muscles. Probably this polarization is produced more immediately in the ponderable solids, by a discharge from a voltaic series, or a wire subjected to electro or magneto-dynamic induction. In the latter instances the shock is reiterated so rapidly as to appear more enduring, while in the former, it is more startling and producible at an infinitely greater distance.

78. Agreeably to Faraday's researches, (1485 to 1543,) there is reason to suppose that in frictional spark discharges, the consequent shock, light, and other peculiarities, are in part owing to waves of ethereo-ponderable polarization, indirectly produced in the intervening gaseous matter. (71.)

Of Ethereo-ponderable Deflagration.

79. It is well known that between two pieces of charcoal severally attached, one to the negative, the other to the positive pole of a numerous and well excited voltaic series, an arch of flame may be produced by moving them apart after contact. This phenomenon evidently depends upon the volatilization of the ponderable matter concerned ; since it cannot be produced before the carbon has been volatilized by contact, nor by any body besides charcoal, this being the only conductor which is sufficiently infusible, and yet duly volatilizable. Metals, similarly treated, fuse at the point of contact and cohere. On separation, after touching, a single spark ensues; which, without repetition of contact, cannot be reproduced. Hence, it may be infer-

These facts appear to me to justify a surmise, that the ethereo-ponderable atoms of iron, in becoming magnetized and demagnetized, co-operate with the ethereo-ponderable atoms of the copper coils in the induction of secondary undulations. It is conceived that these may be owing to the intestinal change, attended by sound, as above stated ; (73;) this being caused by a sudden approximation of the poles of the atoms, previously moved apart by the influence of the galvanized coil. But if this sudden coming together of the previously separated poles of atoms within a magnetized cylinder of iron, can contribute to the energy of secondary waves, it is consistent to infer that these waves owe their origin to an analogous approximation of the separated poles of the cupreous atoms, forming the finer coil in which the secondary undulations may be created, without the presence of iron. Of course this reasoning will apply to all cases in which the phenomena hitherto attributed to Faradian currents are the result of dynamic induction.

Thus it appears that the polarization of magnets, and that created and sustained when a galvanized coil or helix acts upon another in proximity, have the same relation to galvanic discharges that the charges upon insulated surfaces have to their appropriate discharges. The permanent magnetism of steel seems to have some analogy with the charge upon a coated pane, while we may consider as analogous with the charges upon insulated conductors, already adverted to, (61, 62.) that state of the ethereo-ponderable particles (38) of a wire helix, which *state*, resulting from the influence of an included magnet, or neighboring galvanized coil, and being discharged on a change of relative position, or breach of the galvanizing circuit, is productive of spark, shock, ignition, or electrolysis, as exemplified by Callan's coil, Page's electrotome, or the magneto-electric machine.

red, that the carbonaceous vapor is indispensable to this process, as a medium for the ethereo-ponderable polarizing waves, being soon consumed by the surrounding atmospheric oxygen. The excrescence upon the negative charcoal, observed by Silliman, together with the opposite appearance on the positive charcoal, may be owing to the lesser affinity for oxygen on the negative side.*

80. There may be some resemblance imagined between this luminous discharge between the poles, and that which has already been designated as diruptive; (69;) but this flaming arch discharge does not break through the air, it only usurps its place gradually, and then sustains this usurpation. It differs from the other as to its cause, so far as galvanic reaction differs from friction: moreover, it requires a volatilizable, as well as a polarizable ponderable conducting substance to enable its appropriate undulations to meet at a mean distance from the solid polar terminations, whence they respectively proceed.

81. The most appropriate designation of the phenomenon under consideration, is that of ethereo-ponderable undulatory deflagration. Under this head, we may not only place the flaming arch, but likewise the active ignition and dissipation of fine wire or leaf metal, or when attached to one pole, and made barely to touch the other.

82. In one of Faraday's experiments, a circuit was completed by subjecting platina points, severally proceeding from the poles of a voltaic series, while very near to each other, to the flame of a spirit lamp. This was ascribed by him to the rarefaction of the air, but ought, as I think, to be attributed to the polarizable ethereo-ponderable matter of the flame, performing the same office as the volatilized carbon in the flaming arch, between charcoal points, to which reference has been made.

Summary.

From the facts and reasoning which have been above stated, it is presumed that the following deductions may be considered as highly probable, if not altogether susceptible of demonstration.

The theories of Franklin, Dufay, and Ampere, are irreconcilable with the premises on which they are founded, and with facts on all sides admitted.

A charge of frictional electricity, or that species of electric excitement which is produced by friction, is not due to any accumulation, nor to any deficiency either of one or of two fluids, but to the opposite polarities induced in imponderable ethereal matter existing throughout space however otherwise void, and likewise condensed more or less within ponderable bodies, so as to enter into combination with their particles, forming atoms which may be designated as ethereo-ponderable.

Frictional charges of electricity seek the surfaces of bodies to which they may be imparted, without sensibly affecting the ethereo-ponderable matter of which they consist.

When surfaces thus oppositely charged, or, in other words, having about them oppositely polarized ethereal atmospheres, are made to communicate, no current takes place, nor any transfer of the polarized matter: yet any conductor touching both atmospheres, furnishes a channel through which the opposite polarities are reciprocally neutralized by being communicated wave-like to an intermediate point.

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* American Journal of Science, Vol. X. p. 121. 1826.

Galvano-electric discharges are likewise effected by waves of opposite polarization, without any flow of matter meriting to be called a current.

But such waves are not propagated superficially through the purely ethereal medium; they occur in masses formed both of the ethereal and ponderable matter. If the generation of frictional electricity, sufficient to influence the gold leaf electrometer, indicate that there are some purely ethereal waves caused by the galvano-electric reaction, such waves arise from the inductive influence of those created in the ethereo-ponderable matter.

When the intensity of a frictional discharge is increased beyond a certain point, the wire remaining the same, its powers become enfeebled or destroyed by ignition, and ultimately deflagration: if the diameter of the wire be increased, the surface, proportionally augmented, enables more of the ethereal waves to pass superficially, producing proportionally less ethereo-ponderable undulation.

Magnetism, when stationary, as in magnetic needles and other permanent magnets, appears to be owing to an enduring polarization of the ethereo-ponderable atoms, like that transiently produced by a galvanic discharge. (Note page 188, and paragraph 68.)

The magnetism transiently exhibited by a galvanized wire, is due to oppositely polarizing impulses, severally proceeding wave-like to an intermediate part of the circuit where reciprocal neutralization ensues.

When magnetism is produced by a frictional discharge operating upon a conducting wire, it must be deemed a secondary effect, arising from the polarizing influence of the ethereal waves upon the ethereo-ponderable atoms of the wire.

Such waves pass superficially in preference; but when the wire is comparatively small, the reaction between the waves and ethereo-ponderable atoms becomes sufficiently powerful to polarize them, and thus render them competent, for an extremely minute period of time, to produce all the affections of a galvano-electric current, whether of ignition, of electrolysis, or magnetization. Thus, as the ethereo-ponderable waves produce such as are purely ethereal, so purely ethereal waves may produce such as are ethereo-ponderable.

The polarization of air upon electrified scalps is supposed to be due to a superficial association with the surrounding polarized ethereal atoms, while that of iron filings, by a magnet or galvanized wire, is conceived to arise from the influence of polarized ethereo-ponderable atoms, consisting of ethereal and ponderable matter in a state of combination.

Farradian discharges are as truly the effects of static ethereo-ponderable polarization, as those from an electrified conductor, or coated surfaces of glass are due to static ethereal polarization; (39, 40, 41;) last paragraph, note, page 274.

It is well known that if a rod of iron be included in a coil of coated copper wire, on making the coil the medium of a voltaic discharge, the wire is magnetized. Agreeably to a communication from Joule, in the L. and E. Phil. Mag. and Jour. for Feb. 1847, the bar is at the same time lengthened, without any augmentation of bulk; so that its other dimensions must be lessened in proportion to the elongation.

All these facts tend to prove that a change in the relative position of the constituent ethereo-ponderable atoms of iron, accompanies its magnetization, either as an immediate cause, or as a collateral effect.

Method of Welding Iron, Steel, and Sheet Iron.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

In an earthern vessel melt borax, and add to it one-tenth of sal-ammoniac. When these ingredients are properly fused and mixed, pour them out upon an iron plate, and let them cool. There is thus obtained a glassy matter, to which is to be added an equal quantity of quick lime.

The iron and steel which are to be soldered, are first heated to redness, then this compound, first reduced to powder, is laid upon them: the composition melts and runs like sealing wax; the pieces are then replaced in the fire, taking care to heat them at a temperature far below that usually employed in welding: they are then withdrawn and hammered, and the surfaces will be found to be thus perfectly united. The author asserts that this process, which may be applied to welding sheet-iron tubes never fails.

Rec. de la Soc. Polytech. Feb., 1847, p. 135.

New Use of Waste Steam.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A manufacturer who has a steam engine which discharges much waste steam, conceived the idea of using it to raise pine apples. The steam was introduced under the root of the plants, and the heat and moisture united, acted so powerfully, that the pine-apples soon ripened; while the body of the plant being exposed all day to the open air, assumes a healthy and agreeable taste, which renders the fruit far superior to those which have been ripened in hot houses.

Ibid. p. 139.

Method of Bringing Out Sculpture upon Alabaster.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

This process is founded upon the property which alabaster or sulphate of lime nas, of being slowly eaten out by cold water, so that its polish is destroyed.

In the first place the sculptures in relief, and all the parts intended to be preserved, are covered with a varnish insoluble in water, composed of wax dissolved in oil of turpentine, mixed with white lead, or rather with a turpentine varnish, to which white lead and a little animal oil has been added to prevent the varnish from hardening and adhering too strongly to the alabaster. This is applied with a soft paint brush, moistened with oil of turpentine, into which it must be dipped every time that varnish is taken. The reserved parts being thus covered, suffer the vessel or ornament to dry for some hours, and then place it in a vessel filled with cold water, and leave it there for 48 hours, or longer if it is thought necessary. The varnish is then removed with a fine sponge dipped in the oil of turpentine, and the vessel dried with a soft and very dry rag. When the vessel is thus cleared of its varnish, and dried, pass over it a new soft brush. first dipped in finely powdered plaster. This powder fills the pores of the plaster which has been attacked by the water, and renders it mat; which brings out the transparent parts of the alabaster in relief.

To clean ornaments and sculptures in alabaster: wash out any grease spots with oil of turpentine; then put the piece in water, and suffer it to remain until it is freed from its impurities. When you take it out, rub it with a very dry paint brush; let it dry, and pass over it powdered plaster. In this way the piece will be perfectly washed, and will look as though it had just come from the hand of the carver. Ibid, p. 140.

Account of the Experiments to determine the Principal Laws and Numerical Data, which enter into the Calculation of Steam Engines, by M. V. Regnault.

(Continued from page 211.)

For the fourth series of experiments a form of apparatus was devised similar in principle to that just described, but free from its objections. This consisted essentially of a glass globe, of a capacity of from 800 to 2000 cubic centimetres, to which was added a capillary stem about 20 centimetres long. The globe was placed in an appropriate metallic vessel, so that it could be alternately heated to 100°, and cooled to 0°; the tube passing out of a lateral opening terminated in a small copper pipe which had two other openings—one of these was for the moment closed, the other communicated with the apparatus for drying the air, by whose means the globe and tube were filled with dry air with the usual precautions. Another glass tube of 16 or 17 millimetres internal diameter was cemented at its lower end into an iron cap terminated below by a stop-cock, and carrying a lateral branch bent parallel to the axis of the tube; into this lateral branch was cemented a second tube, which was for a certain distance of the same diameter as the first, and terminated above by a capillary tube, a part of that which formed the neck of the globe, which was bent at right angles. This system of tubes being firmly and carefully adjusted in a vertical position, the second tube with its attached capillary branch was carefully dried and filled with boiled mercury, and the upper part of the capillary tube, which was of course horizontal, was then fitted into the third opening of the small copper tube, so as to be in immediate communication with the neck of the globe. When firmly fixed, the stop-cock at the bottom of the compound tube was opened, and the mercury flowing slowly out was replaced by air drawn through the drying apparatus, and the apparatus filled with air to a certain mark, a, placed upon the vertical tube, where it was of greatest diameter, the glass globe being all the time immersed in boiling water: the drying apparatus was then removed, and the branch of the copper tube with which it communicated hermetically sealed, and the height of the barometer noted. The hot water was then discharged from around the globe, and replaced first by cold water and afterwards by pounded ice, the level of the mercury being kept at a, by suffering it to flow off when necessary by the stop-cock. When the globe has certainly reached the temperature of the ice, the barometer is read, and the difference of the heights of the mercury in the two communicating vertical tubes is measured. We have thus all the data for calculating the coefficient of dilatation of the air, but another observation may be had by reversing the experiment. To do this, re-connect the drying apparatus with the copper tube, the mercury will fall in the vertical tube in connexion with the globe, but must be kept at a by pouring mercury into the other vertical tube: when equilibrium has been attained, remove the drying apparatus, and close its branch of the copper tube, then replace the ice by boiling water, and repress the dilatation of the air by pouring more mercury into the vertical tube; when you are satisfied that the air has taken the temperature of boiling water, read the barometer, and measure the difference of the heights of the mercury in the two vertical tubes.

The mean of six experiments tried in this way gave 1·3665 for the coefficient of dilatation: the maximum result being 1·36710; the minimum 1·36580; difference $\frac{1}{1051}$ of the mean.

By this method the dilatation of the air is determined under very different pressures; in fact, during the first period of every experiment, the air is under the atmospheric pressure 0·760 metre when at 100°, and only under the pressure of 0·550 metre when at 0°. In the second period, the air at 0°, is under the atmospheric pressure 0·760m., and when heated to 100° under the pressure of about 1·040m. It is even easy to arrange the apparatus so that the experiment may be tried under still greater differences of pressure. As the experiments showed no difference in the numbers obtained during these periods, (1.36655 during the first, and 1·36645 during the second period,) we must conclude that within these limits of pressure, the coefficient of dilatation of air is sensibly constant.

Fifth series of experiments. In all the experiments hitherto described, the dilatation of the gas was determined indirectly from a direct measurement of the augmentation of its elastic force when brought to a constant volume at a higher temperature, assuming the truth of the law of Mariotte. In order to get the dilatation directly, the gas enclosed in an eminently elastic envelope should dilate freely without changing its elastic force, and the augmentation of volume must be carefully measured, the gas being all at the same temperature. It is difficult to see how these conditions can be realized in practice, but it may be done approximately by following the method adopted by M. Pouillet in his air pyrometer. (Traitè de Physique, 4me edit. tome 1, p. 255.) In this way the elastic force of the gas remains sensibly the same, but a very notable portion in the reservoir of dilatation is at a temperature but slightly differing from that of the surrounding air.

The apparatus used by M. Regnault was to a great extent similar to that just described, but the iron cap into which the two vertical tubes were cemented was differently adjusted. It had two stop-cocks by one of which the barometric tube could be made to communicate at pleasure with the exterior, while the other, which was placed under the tube in communication with the globe, was so bored that it might make a communication either between the two tubes or between this second vertical tube and the external air. These two tubes were placed in a glass vessel which could be filled with water so that they could be maintained at any and a uniform temperature. The experiment was conducted as follows: The globe being surrounded with ice, and the communication with the drying apparatus opened, the level of the mercury was brought to the mark α on the vertical tube; the communication between the two tubes being open, the mercury would of course be at the same height in both tubes; the communication with the drying apparatus was closed, the barometer and the temperature of the water around the tubes noted. The globe was then brought to 100°, the mercury in the vertical tube was of course depressed, and in order to keep that in the barometric tube, at about the same level with it, its stop-cock had to be opened and the mercury suffered to flow out; the two columns were thus kept nearly at the same height, that in the tube in which the air was dilating, being brought to a second mark β, and the exact difference in the heights of the two columns was carefully noted, as well as the height of the barometer, and the temperature of the water in the surrounding vessel. In order from this experiment to determine the dilatation of the air, it is only necessary to know the capacity of the globe, and of its stem as far as the mark α, and that of the vertical tube between α and β; these are all easily determined by the weight of pure mercury necessary to fill them.

Four experiments tried in this way gave a mean dilatation of 1·36706. The maximum being 1·36718; the minimum 1·36693; difference $\frac{1}{5168}$ of the mean. The coefficient of dilatation given by this fifth method is sensibly greater than that got from the others. This circumstance is not accidental, as in the second part of the memoir, similar differences are shown for other gases, and in certain cases these differences are very considerable.*

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* M. Regnault describes in a note an independent series of experiments tried by him according to the method of M. Gay Lussac—that is, by observing the dilatations of a quantity of dry air contained in a true thermometer and separated from the external atmosphere by a small index of mercury. (Biot, Traitè de Phys. tom. 1, p. 182.) The results obtained did not agree at all, and were all feebler than by any of the other methods; the highest result recorded was 1·3647.

M. Regnault then proceeds to the discussion of his formulae, for the purpose of determining the probable error in his results, and he shows that in the first three series—principally owing to the uncertainty of the readings of the barometer within $\frac{1}{10}$ millimetre, the maximum probable error is about $\frac{1}{1000}$, which is about the greatest difference between the maximum and minimum results in any one series. The two last series include the same source of error, and another arising from the uncertainty of the temperature of the air in the capillary tube, which, however, he believes may be altogether neglected in his experiments, the apparatus having been carefully arranged so as to make this a very small fraction of the whole volume of air under experiment.

He finally assumes 0·003665 as the mean coefficient of dilatation of dry atmospheric air as determined by the first four series of experiments, and remarks that the number 0·00367 given by the fifth series must be adopted in experiments where the gas dilates freely and preserves its original elastic force. He also gives as a fraction easily recollected, the remark of M. Babinet than 0·00366666 would be expressed by $\frac{11}{30}$.

PART SECOND.

On the Dilatation of some other Gases under Pressures near that of the Atmosphere.

Physical philosophers admitted that all gases had the same coefficient of dilatation, but since so serious an error in the numerical value of this coefficient had been shown, it was necessary to submit this law also to verification, the result of which was to show its incorrectness. The experiments were tried chiefly by the method I and IV under constant volumes, and V under constant pressure. It is not necessary to describe them in detail, as M. Regnault has done, nor to give the methods by which the gases were purified, suffice it to say that all necessary precautions were taken, and the general results were as follows:—

	Coefficient of Dilatation from 0° to 100°.	
	Under constant volume.	Under constant pressure.
Hydrogen,	0·3667	0·3661
Atmospheric Air,	0·3665	0·3670
Nitrogen,	0·3668	"
Oxide of Carbon,	0·3667	0·3669
Carbonic Acid,	0·3688	0·3710
Nitrous Oxide,	0·3676	0·3719
Sulphurous Acid,	0·3845	0·3903
Cyanogen,	0·3829	0·3877

He also describes an apparatus, an easily imagined modification of method IV, by which the difference in the coefficient of dilatation of any two gases may be at once shown.

PART THIRD.

On the Dilatation of Gases under Different Pressures.

It has been generally admitted that the dilatation of gases is constant between the same limits of temperature, no matter to what pressure they may be submitted; consequently, that it is altogether independent of their initial density. But it is difficult to cite conclusive experiments upon which this law is founded. Several observers having obtained the same value for the coefficient of dilatation of air, under different barometric pressures, concluded that the coefficient of dilatation of gases was constant under all pressures: but the barometric variations in any place are not sufficiently extensive to permit so general a conclusion to be thus deduced.

Sir Humphrey Davy is the only philosopher who has studied the dilatation of gases under very different pressures. (Phil. Trans. 1823, vol. ii, p. 204.

He states that he found the same dilatation for air taken with the densities $\frac{1}{6}$, $\frac{1}{3}$, $\frac{1}{2}$, 1, and 2; but his experiments were not made by a sufficiently delicate method to allow his results to be considered exact.

The experiments of M. Regnault upon this subject were tried with apparatus of the same character as those before described, as methods IV and V, with such modifications as the peculiar circumstances of the experiments rendered necessary: and the conclusion at which he arrived was that "*the air dilutes, within the same limits of temperature, by quantities which are greater in proportion as the density of the gas is greater: that is, in proportion as its molecules are brought nearer to each other.*"

The following tables exhibit the results of his experiments upon air, carbonic acid, and sulphurous acid:

Dilatation of Gases under different Pressures, determined by the method of Constant Volumes. (II and IV.)

Atmospheric Air.

Pressure at 0°. Millimetres.	Pressure at 100°. Millimetres.	Density of the air at 0°. that of air at 0°, under a pressure of 760 millimetres = 1.	Volume of the air at 100°, that at 0° = 1.
109·72	149·31	0·1444	1·36482
174·36	237·17	0·2294	1·36513
266·06	395·07	0·3501	1·36542
374·67	510·35	0·4930	1·36587
375·23	510·97	0·4937	1·36572
760·00		1·0000	1·36650
1678·40	2286·09	2·2084	1·36760
1692·53	2306·23	2·2270	1·36800
2144·18	2924·04	2·8213	1·36894
3655·56	4992·09	4·8100	1·37091

Carbonic Acid.

758·47	1034·54	1·0000	1·36856
901·09	1230·37	1·1879	1·36943
1742·73	2387·72	2·2976	1·37523
3589·07	4759·03	4·7318	1·38598

Dilutation of Gases under different Pressures, determined by the method of Constant Pressures. (V.)

ATMOSPHERIC AIR.		CARBONIC ACID.		HYDROGEN.		SULPHUROUS ACID.		
Pressure Milli	Volume at 100°.	Pressure Milli.	Volume at 100°.	Pressure Milli.	Volume at 100°.	Pressure at 0°.	Pressure at 100°	Volume at 100°.
760	1·36706	760	1.37099	760	1·36613	760·00	760·00	1·39020
2525	1·36944	2520	1·38455	2545	1·36616	982·73	987·61	1·39804
2620	1·36964							

The general conclusions of this memoir are as follows:

1st. The coefficient of dilatation of air, 0·375, heretofore admitted by philosophers from the experiments of M. Gay Lussac, is much too great for dry air under the ordinary atmospheric pressure.

The coefficient 0·3645, which is the mean of the experiments published by M. Rudberg, is too small.

When the coefficient of dilatation of air is deduced by calculation, from the changes of elastic force which the same volume of gas undergoes when carried from 0° to 100°, its value is 0·3665.

But when this coefficient is deduced from the changes of volume of the same mass of gas in passing from 0° to 100°, its elastic force remaining constant, we find a value rather higher: that is—0·3670.

2nd. The coefficients of dilatation of the different gases are not equal, as has been hitherto admitted; they present on the contrary, notable differences, as may be seen by the numbers before cited.

There is often obtained for the same gas, very different values for its coefficient of dilatation, according as this is deduced immediately from the observation of the change of volume which the same mass of gas undergoes between 0° and 100°, its elastic force remaining the same, or calculated from the variation in the elastic force of the gas between 0° and 100°, its volume remaining constant.

3rd. The air and all other gases, except hydrogen, have greater coefficients of dilatation in proportion as their density increases.

4th. The coefficients of dilatation of the different gases approach nearer equality, as their pressures are lighter; so that the law which is thus expressed, "*all gases have the same coefficient of dilatation*," may be considered as a limiting law which is applicable to gases in a state of extreme dilatation; but which is farther from the truth in proportion as the gases are more compressed, or, in other words, as their molecules are brought nearer together.

(To be Continued.)

New Arrangement for Gas Burners, by M. Maccaud.

We find in the Bulletin of the Society for the Encouragement of National Industry, for February, 1847, a report by M. Payen, from a committee of the society, appointed to examine a new arrangement of gas burner, invented and submitted to the society by M. Maccaud, of Lyons.

The modification consists in an envelope of wire gauze, through which the air which is to support the combustion passes. This envelope produces two useful effects: the heat acquired by the wire gauze is transmitted to the air, and augments the light of the lamp; and at the same time the flame becomes more regular. The lamp submitted by M. Maccaud was an argand gas burner of twenty tubes; the gallery which supports the glass chimney is fitted with a wire gauze which surrounds the base of the chimney, and is prolonged downwards in a funnel form to the bottom of the burner. It was compared with another similar argand burner without the wire gauze, each giving a light equal to that of a Carcel lamp, burning 1½ oz. of oil per hour—where it was found that the expense per hour of the Maccaud burner was to that of the other lamp as 110 to 123, or as 100 to 111·8.

Fig. 1.

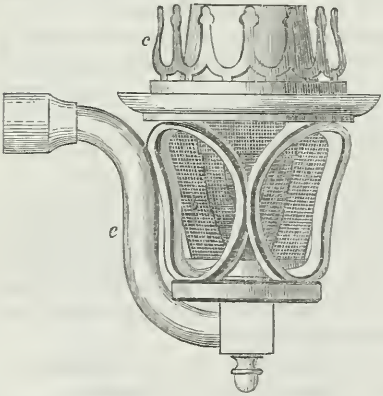


Fig. 2.

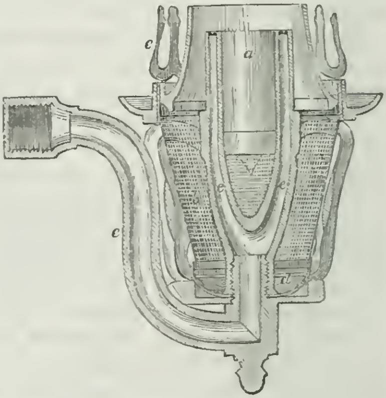


Fig. 3.

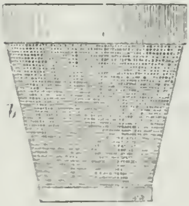
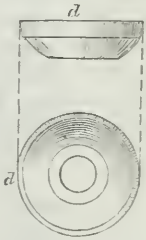


Fig. 4.



The use of the wire gauze renders the flame steady even when exposed to strong currents of air, so that when a window or door was suddenly opened, the flame remained unaffected, while that of the common lamp became red and smoky.

The committee also examined the behavior of these lamps as contrasted with that of ordinary gas burners in the open air, and especially in doorways and staircases, where the lamps were constantly exposed to draughts, and found that the flame of the Maccaud lamp was always unaffected, while that of the ordinary lamp was so much affected that the glass chimneys were constantly broken by the sudden deviations caused by the currents of air.

In certain particular cases, and where the lamps are to be constantly exposed to very strong currents of air, M. Maccaud covers the upper part of the glass chimney with a conical cap of wire gauze, which prevents the wind from driving the flame downwards; the wire gauze which he uses contains from 40 to 80 wires to the inch.

The invention above described is so simple that it seems incredible that it should never have been invented before. The high authority of the society from which the report emanates, as well as the known personal reputation of the reporter of the committee, are sufficient guarantees for the accuracy of the facts. As to the utility of it, it is unnecessary that we should dwell upon it in this climate where our houses are all open on summer nights, and not unfrequently the wind blows with such violence as to render it impossible to keep a common gas-light burning. When furnished with the cap, it will also prevent insects from accumulating upon the burner. The principle is also manifestly applicable to our street lamps, and would much benefit them in stormy nights.

Bull. Soc. Enc. Ind. Nat.

An Improved Manometer. *By* M. Galy Cazalat.

"In the manometer, of which the use is prescribed (in France) by the ordinance of May 22nd, 1843, the glass tube must exceed in height as many times 76 centimetres (30 inches), as the pressure of the steam exceeds an atmosphere.

"In order to shorten the column of mercury, the weight of which balances the force, it has occurred to me to oppose to the pressure of the steam the horizontal end of the rod of a piston, moving without friction, and steam-tight, which, by descending, causes the mercury to rise in the glass tube. According to this arrangement, if the area of the end pressed by the steam be n times smaller than that of the piston pressed by the mercury, this latter will rise in the tube to a height n times less than in the usual manometer."

It will be evident that the only practical difficulty to be overcome in this arrangement, is to render this piston *steam-tight*, at the same time that it shall move without friction. This object is attained, however, by the use of diaphragms elastic and impermeable interposed between the ends of the piston, and the mercury or steam.

With these remarks, a glance at the accompanying sketch, with reference to the explanations, will render further description unnecessary.

The moving principle is the brass piston *c*, on which impinges, and which transmits to the mercury, the pressure which the steam exercises on the horizontal end of its rod *d*. For this purpose, the piston rod moves without friction in a central bushing of copper *e*, attached in

Fig. 1.

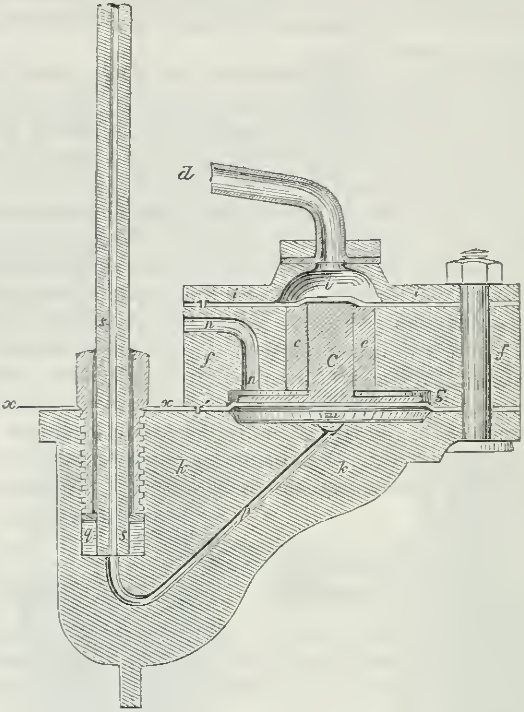
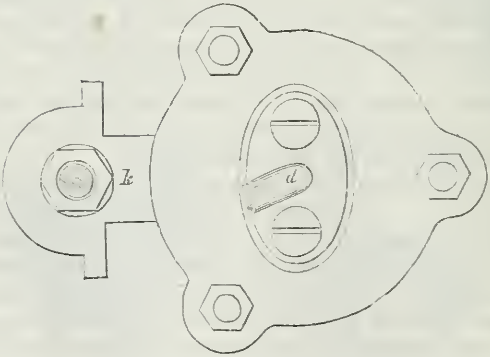


Fig. 2.



an iron cylinder *f*, of which the lower face is recessed at *g*, to receive the disc or piston *c*. The two ends of this cylinder are each covered with a flexible and impermeable membrane (as, for example, caoutchouc) *v*, *v*. These two membranes are confined by the flanch *i*, *i*, and the base *k*, *k*, which form the cavities *l*, *m*; the upper one is full of water which communicates with the steam from the boiler by the tube *d;* while the lower is full of mercury by the canal *p*, with a vertical cylindric reservoir *q*, in which is attached the gauge tube *s; n* is a canal to conduct air to or from the upper face of the piston *c*, at its upper end, the tube terminates in a bulb (not shown) to receive any mercury which may be blown out.

The space in height, occupied by this apparatus, is evidently at the option of the maker; but for locomotives, 4 centimetres (1·57 inches) per atmosphere, is found to be a good scale; in which case, the relation of the two ends of the piston will be as 19 to 1; and for 7 atmospheres the whole height of the tube will be only 11·2 inches. Ibid.

Method of Closing Glass Vessels Hermetically.

M. Maissiot, of Paris, has proposed the following method of closing glass vessels of every size hermetically.

The mouth of the glass vessel is ground upon the top, and a glass plate ground so as to fit accurately upon it. A quantity of caoutchouc is then melted, (the addition of $\frac{1}{18}$ of its weight of tallow assists the melting and does not hurt the preparation,) the heat must be gentle and carefully regulated, and the matter must be constantly stirred; if the heat be raised too high it will be indicated by thick fumes. As soon as it is nearly fused, slacked and sifted lime is added, little by little, the paste being constantly stirred with a spatula. Immediately the strong smell of caoutchouc diminishes, and soon disappears entirely. It is then replaced by a peculiar odor which indicates that the operation has been well performed, and that the caoutchouc has combined intimately with a portion of the lime. The excess of this alkali plays the part of an inert powder, by which you may give the cement any consistence desirable. When it is as thick and tenacious as you want it, withdraw the vessel from the fire, and the cement is made. This cement possesses a remarkable plasticity, it appears scarcely to dry up; after a year's use, it does not appear to have in the least changed its properties. The property of hardening in time may be given to it by the addition of proper quantities of the compounds of lead. A thin coat of this cement is then spread with a knife over the edges of the vessel, and the cover being applied to it, pressed with the finger in the centre, and turned round for a moment, so as to spread the cement evenly, the joint will be found completely air-tight. The softness of the cement does not prevent it from adhering strongly to the glass. Thus, filling a cylindrical vessel of six inches in diameter, and immediately turning it upside down, the cover was not forced off, nor did the liquid leak.

M. Maissiot has enclosed in this way concentrated alcohol with a vacuum over it, which, after many months, remains perfect. This method will be found very advantageous for the preservation of preserves, fruits, and meats, by Appert's process, as well as for anatomical preparations, &c. Ibid.

Substitute for White Lead, &c.

M. Leclaire exhibited to the Academy, several specimens of painting, intended to show the advantages which colors with a zinc base possess over those whose base is lead or copper. The first, after being exposed to the action of sulphuretted hydrogen, preserved their lustre completely, while the others were all more or less altered.

The dangers to which the workmen who prepare them are exposed, or those even who employ only white lead, caused the white of zinc to be thought of long ago as a substitute; but besides the fact that there were no establishments in which this product was manufactured upon a large scale, and by an economical process, there remained another cause of unhealthiness in the necessity of employing oil prepared with litharge, as a drying oil, as well for the zinc as for the lead. M. Leclaire has got rid of this last cause of danger, by the discovery of a drying medium, whose base is manganese, the employment of which presents no inconvenience.

In painting houses, white lead is not the only poisonous material which is used; several other colors of lead and copper base are still generally employed. M. Leclaire has succeeded in replacing them by colors with zinc as the base, the use of which has not, up to the present time, appeared to injure the health of the workmen.

Comptes Rendus de l'Academie des Sciences, Jan. 24, 1848.

FRANKLIN INSTITUTE.

Monthly Meeting, March 16th, 1848. Mr. Oran Colton *presiding.*

The following donations were announced:

From Hon. Joseph R. Ingersoll, H. R.—
  Message of the President of the United States to the two Houses of Congress, at the commencement of the first session of the 30th Congress. Washington, 1847.
From Hon. James D. Westcott, Jr., Sen—
  Report of the Committee on Patents, (Senate.) No. 50.
From Col. S. H. Long, U. S. Top. Eng.—
  The relative cost of Steam and Water Power; the Illinois Coal Field; and the advantages offered by the West, particularly on the lower Ohio, for Manufacturing. Louisville, Kentucky, 1848.
From the Massachusetts Charitable Mechanics' Association of Boston
  Exhibition of the Massachusetts Charitable Mechanics' Association, at Faneuil and Quincey Halls, in the city of Boston, September, 1847. Boston, 1848.
From Hon. Thomas H. Forsyth, Esq., Senate, Pennsylvania—
  Communication from the Auditor General, relative to the Banks and Savings Institutions of the Commonwealth. Harrisburg, 1848.
  Tabular Statement relative to the State Tax on real and personal property, and to Common Schools. Harrisburg, 1848.

Senate file from No. 308 to No. 514.

House file from No. 404 to No. 522.

From Hon. Sol. W. Roberts, Esq.—

Communication from the Auditor General relative to the Banks and Savings Institutions of the Commonwealth. Harrisburg, 1848.

Tabular Statement relative to the State Tax on real and personal property, and to Common Schools. Harrisburg, 1848.

The Daily Legislative Record, to 14th March inclusive.

From Frederic Graff, Esq.—

Annual report of the Watering Committee for the year 1847, to the Select and Common Councils of the city of Philadelphia. Philadelphia, 1848.

From W. H. Dillingham, Esq.—

An Oration delivered before the Society of the Sons of New England of Philadelphia, December 15, 1847—the Anniversary of the Landing of the Pilgrims, by Wm. H. Dillingham, Philadelphia, 1847.

From Prof. James C. Booth—

The Encyclopedia of Chemistry, Theoretical and Practical, presenting a complete and extended view of the present state of Chemical Science, by James C. Booth, assisted by Campbell Morfit. Philadelphia—Carey & Hart.

From A. B. Hutton—

The Annual report of the Board of Directors of the Pennsylvania Institution for the Deaf and Dumb, for 1847. Philadelphia, 1848.

Anonymous—

An Examination of the legality of the General Orders which confer assimilated rank on officers of the Civil Branch of United States Navy. Philadelphia, 1848.

The Reports of Officers and Standing Committees were received.

A report was received from the committee on Mr. Elliot Cresson's proposition to found a medal, containing the following resolutions:

Resolved, That the corresponding secretary be directed to present the thanks of the Institute to Elliot Cresson, Esq., for the liberality and confidence manifested by him in placing at the disposal of the Institute, a fund for the perpetual award of a gold medal.

Resolved, That the President and Secretary be authorized to affix the seal of the Institute to the Deed of Trust, executed by Elliot Cresson, Esq., in relation to said medal, and the fund provided for the procuring thereof, in attestation of the acceptance of the same on the part of the Institute.

The resolutions on the report were adopted.

On motion of Mr. Weigand, the deed of trust was directed to be entered at large upon the minutes. The following is an abstract of its provisions:—

The Trust Deed assigns to Frederick Fraley and John Weigand, trustees, and their successors in the trust, one thousand dollars of the six per cent. convertible loan of the Schuylkill Navigation Company, reimbursable in 1866, subject to the following trusts:

I. Provides for keeping the principal as at present invested, until paid off, then to reinvest in such funds as are designated by law for the investment of trust funds.

II. Suitable dies for the gold medal to be provided out of the first sufficient interest, and describes the devices and legends which shall be engraved upon the dies.

III. "After the said dies have been so prepared and paid for, out of the said money received for interest, the said parties of the second part, shall cause to be struck therefrom, from time to time, as the interest accruing on, and received from, the said sum of one thousand dollars will procure and pay for, such number of gold medals as the said interest will justify, and deliver the same to the Treasurer of the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to be by him delivered to such persons or parties as the said Franklin Institute by any rule or regulation they may adopt, may have awarded the same. The said awards, however, in all instances to be made either for some discovery in the arts or sciences, or for the invention or improvement of some useful machine, or for some new process or combination of materials in manufactures, or for ingenuity, skill, or perfection in workmanship. And the said treasurer shall from time to time as he may receive any such medals, give receipts to the said second parties therefor, and whenever he may deliver any medal, he shall take duplicate receipts therefor from the party receiving the same, one of which receipts shall be delivered to the said second parties, and the other shall be filed in the archives of the said Franklin Institute, and annually, at the stated meeting of the said Franklin Institute, in the month of January, the said parties of the second part shall present to the said meeting, a statement of the accounts of their trust, showing the amount of the said principal sum, how the same is then invested, what interest or increase has been received therefrom during the preceding year, what amount has been expended and for what purposes, the number of medals delivered to the said treasurer, and the number thereof that he has delivered under the awards of the said Institute; which statement shall be filed among the archives of the said Institute."

IV. Provides, that in case of death or disqualification of either of the trustees, the other shall give notice to the Institute, who at their next stated meeting shall elect a successor.

Mr. G. W. Smith announced the death of Dr. Thomas P. Jones, the editor of the Journal, and after a brief notice of his life, it was, on motion, resolved that the President be requested to appoint a committee to draft a series of resolutions expressive of the regret of the Franklin Institute at the death of Dr. Jones.

The business of the meeting being concluded, Mr G. W. Smith exhibited and explained a model of Eckel's steam gauge; this consists of a small brass cylinder or tube placed outside of the boilers, and connected by tubes furnished with stopcocks, with the steam space in the boiler above, and with the water space below. These cocks being open, the water level in the gauge will be the same as in the boiler. When the water level is to be tried, the lower cock is stopped, by which the connexion with the water of the boiler is cut off, and the water is then discharged by the pressure of the steam, from the gauge through another stopcock into a graduated vessel, and the height at which it stood in the tube, thus determined.

Mr. Heckcrote was introduced to the meeting, and exhibited and explained a self-acting, attaching, and detaching car coupling, invented by him. This apparatus consists of a flat box with an opening in one side, into which the coupling bar passes, the sides of this opening flare outwards in curved directions, so that in whatever direction the bar is presented, it will be guided into the opening. The bar is made with a head, which, in entering, passes between a revolving cylinder or friction roller, and a tumbler, which it causes to rotate until it is caught by a trigger, pressed against it by a spring. The head of the coupling bar is then securely fixed, and cannot be disengaged without a backward rotation of the tumbler, which is prevented by the trigger. The peculiar arrangement will allow the bar to take any angle without diminishing the security of its hold. The trigger by which it is secured projects outwards, and is so arranged that if the cars take a very oblique position in reference to each other, (as if one should run off the track,) the trigger lever will be struck by the car, and the two cars will be detached from each other; each car has one of these coupling boxes, and the triggers project on different sides of the axis of the car, so that it cannot move off on either side without detaching the cars. Mr. H. stated that he had tried this invention practically by causing the front one of two cars thus connected to run upon a side track, while by suddenly reversing the switch, the hinder car was forced upon the main track, the cars were instantly detached from each other. With this coupling there is no danger of mutilation in connecting and disconnecting cars, and far less liability to accident in the event of the running the engine off the track, or of the breaking of an axle of a car.

Mr. J. B. Reynolds explained a model of a new method of producing a rotary motion for grindstones, &c., invented by Dr. Winslow, of this city. The stone is supported exteriorly upon an ordinary bearing, but upon the inner side the axis terminates in a hollow cylinder or cup, into which the extremity of the axle of the apparatus fits, upon the end of this axle is fitted a strong wooden tooth movable upon a centre so placed that while the axle rotates in one direction it presses upon the inside of the cup, and thus causes the stone to rotate with the axle; but when the axle moves in the opposite direction, the tooth moves back upon its centre, and no longer presses upon the cup, the stone then does not partake in the motion of the axle. Around the axle is wrapped a cord terminating in a loop to be turned by the foot, and when the motion of the foot ceases the axle is brought back by another cord wrapped around it in the opposite direction, and connected with a strong spring. Thus, when the foot presses downward, the axle rotates, and the tooth pressing upon the cup-shaped bearing of the stone, gives it a rotary motion; but when the motion of the foot ceases, and the axle moves back, the tooth is disengaged from the bearing of the stone which is left free to continue its rotation; the reapplication of the foot then operates to give it motion again, and thus a much higher velocity can be obtained than by the ordinary treadle.

Correction of an Error in our Report of Mr. Pantoleon's remarks on the sounds of all languages given in our March No., page 219.

"There are in all languages fifty-four articulations practically regarded as simple, eight tonic inflections, and twenty-one blended sounds —forming Comstock's universal alphabet of eighty-three letters—the only one in which tones are represented, which are so necessary in distinguishing words having the same articulation, such as *miner, minor, rite, wright, right, write, ail, ale, &c.* A strictly analytic alphabet would contain only twelve symbols; but these minute divisions of sound could not be applied to practice any more than quarter-tones in musical notation."

Baltimore Exhibition of American Manufactures.

We see by a printed circular which has been laid upon our table, that an endeavor is about to be made to get up an Exhibition of American Manufactures in Baltimore. The circular comes at so late an hour, that we can but allude to it, and ask for it the attention of our readers; and we hope that every citizen of our country will contribute what lies in his power, to the success of so deserving an endeavor, and to the progress of the system of public exhibitions of American Manufactures, which has done so much already for the arts of America.

The exhibition is to commence on the 17th of May next, and continue two weeks; the rooms will be opened for the reception of goods, from the 11th of May until the 17th.

All communications upon the subject must be addressed to B. S. Benson, Superintendent. Baltimore, Maryland.

It is our painful duty to announce to our readers the death of Dr. Thomas P. Jones, whose name has been for so long a time familiar to them as Editor of this Journal. Dr. Jones died at Washington, on the 11th instant, in the 75th year of his age.

This event having occurred while the Journal is going through the press, we cannot dwell upon it more at length, at present, but will take the opportunity in a future number, of doing justice to the memory of one, who has deserved so well of all friends of the mechanic arts.

ENGLISH AND FOREIGN

MINING GLOSSARY.

To which is added, the Smelting Terms used in France, Spain, and Germany.

From the London Mining Journal, and Railway and Commercial Gazelle.

CORNWALL MINING TERMS.

Acicular—Slender, straight, crystals.

Adit level—A horizontal excavation, through which the water drawn from the bottoms of the mine thereto by the engine, and that from above, passes off to the surface. This level is usually commenced from the bottom of the deepest neighboring vale, and extended throughout a great part of the mine.

Adventurers—Those who have shares in a mine. According to Pryce, in his *Mineralogia Cornubiensis*, *In*-adventurers are shareholders who attend to the working, and supply goods, out of which they benefit themselves. *Out*-adventurers are those who pay their *quota* of the expenses, without attending to the management of the mine, or benefiting by any supplies.

Aggregated—When the component parts only adhere together, and may be separated by mechanical means.

Air-machine—An apparatus for forcing fresh air into, or withdrawing foul air from, badly-ventilated places.

Air-pipes—Tubes or pipes of iron or wood for ventilating underground, or for the conveyance of fresh air into levels having but one communication with the atmosphere, and, consequently, no current of air.

Aitch-piece—That part of a plunger lift in which the clacks are fixed.

Alliaceous—The garlic odor of arsenical minerals when heated or struck.

Amorphous—Without form.

Anhydrous—Without water of crystalisation.

Arch—A piece of ground left unworked near a shaft.

Arched—The roads in a mine, when built with stones or bricks, are generally arched level drifts.

Argillaceous—Consisting of clay.

Arborescent—Ramifying like a tree.

Arseniate—The arsenic acid united with a base, as copper in the arseniate of copper.

Attle—Rubbish, containing little or no ore.

Average produce—The quantity of fine copper contained in 100 parts of ore; thus, a parcel of ore, having a produce of 10⅝, contains 10⅝ per cent. of copper, being rather above the average of copper ores in Cornwall.

Average standard—The price per ton of fine copper in the ore, after deducting returning charges for smelting, of 2*l.* 15s. per ton of ore in Cornwall, and 2*l.* 5s. per ton of ore at Swansea. The regulation of the standard depends entirely on the price which fine copper bears in the market, rising and falling in the same proportion. Supposing the produce of a parcel of ore to be 10, and the price at which it was sold to the smelter to be 8*l.* 18s., the standard of that parcel will be thus obtained:—10 tons of the ore will be required to yield 1 ton of fine copper—therefore, 8*l.* 18s. × 10 = 89*l.* will be the value of the ore containing a ton of metal. For the same reason, the returning charge of 2*l.* 15s. must be multiplied by 10, making 27*l.* 10s., which, added to the former sum of 89*l.*, makes 116*l.* 10s. being the standard of that parcel. Low produce ore will naturally have a higher standard.

Axis of a crystal—The lateral planes surround its axis, which is an imaginary line passing down the middle of the prism from the centre of the upper to that of the lower terminal plane.

Back—The back of a lode is the part nearest the surface. The back of a level is that portion of the lode extending above it to within a small distance of the level next above.

Bal—The miner's term for a mine.

Batch of ores—Certain quantity of ore sent to the surface by any *pair* of men.

Bar of ground—A vein of a different description of rock, &c., from that in its vicinity.

Base—The substance to which an acid is united.

Bearers—Supports to the pumps in the engine-shaft.
Beat away—To excavate; usually applied to hard ground.
Bed—A seam, or horizontal vein of ore.
Bend—Indurated clay; a name given by miners to any indurated argillaceous substance.
Bit—The steeled end of a borer.
Black jack—Blende.
Blende—One of the ores of zinc, composed of iron, zinc, sulphur, silex, and water; on being scratched it emits a phosphoric light.
Black tin—Tin ore ready for smelting.
Blast holes—The holes through which the water enters the "windbore," or bottom of a pump.
Block tin—Metallic tin.
Blast—The air introduced into a furnace.
Blasting—Forcing off portions of rock by means of gunpowder. A hole is made with a borer, into which gunpowder is inserted, then confined, and set fire to.
Blower—A smelter.
Bounds—The proprietary of tin ore over a given tract.
Bob—The engine beam.
Bowlders—Large stones or pebbles.
Botryoidal—Globular forms, such as are found in copper, &c.
Borer—A boring instrument, with a piece of steel at the end, called a boring bit.
Brace—The mouth of a shaft.
Branch—A small vein which separates from the lode, and very generally again unites therewith.
Brood—Impurities mixed with the ores.
Bryle—The traces of the presence of a lode, found in the loose matter, on or near the surface.
Buckers—Bruisers of the ore.
Bucket—The piston of the lifting pump.
Bucket tift—A set of iron pipes attached to a lifting pump.
Bucket rods—Wood rods, to which the piston of a lifting pump is attached.
Bucking iron—The iron or tool with which the ore is pulverised.
Bucking plate—An iron plate on which the ore is placed for being bucked.
Buddling—Separating the ores from the earthy substance by means of an inclined hutch or cistern.
Bunch, or squat of ore—A quantity of ore of small extent; more than a stone, and not so much as a course.
Burden, or overburn—The substances reposing on a bed of stream tin ore.
Burning house—The furnace in which tin ores are calcined to sublime the sulphur from pyrites; the latter being thus decomposed, are more readily removed by washing.
Burrow—A heap of deads, attle, rubbish.
Cage of a whim—The barrel on which the rope is wound up.
Cal—Wolfram.
Cand or Kand—Fluor.
Capel—A stone composed of quartz, schorl, and hornblende, usually occurring on one or both walls of a lode, and more frequently accompanying tin than copper ores.
Captain—One of the superintendents of the mine.
Captain dresser—Superintendent of the dressing of the ores.
Carrack—See *Capel.*
Cases of spar—Veins of quartz (not containing ores) which have not a direction parallel to the lodes.
Casing—A division of wood planks, separating a foot way, or a whim, or engine-shaft, from one another.
Cathead—A smaller capstan.
Caunter lode—A lode which inclines at a considerable angle with the direction of the other lodes in its vicinity.
Charger—An implement in the form of the bit of a carpenter's auger, for charging holes for blasting, which are dug horizontally.
Chimming—A process of similar effect to tossing, but being performed on small quantities of ore, the keeve is supported on the verge of its bottom.
Clack—The valve of a pump of any description.
Clack door—The aperture through which the clack of a pump is fixed and removed.
Claying—Lining the hole (in which gunpowder is to be placed) with clay, to prevent the powder becoming damp.

Cob—To break the ores with hammers in such a manner as to separate the dead or worthless parts.

Cockle—Schorl.

Coffin—Old workings open to the day.

Cost Book—Cornish mines carried on upon the cost-book system, as was described in an article on "Mining and Railway Liabilities" in the *Mining Journal*, do not come under the effect of the New Joint-Stock Registration Act, but are regulated by the stannary laws of Cornwall. The plan is to insert in the "cost book" the name and address of each of the adventurers who first commence working the mine, all subsequent transfers of shares, and every expense attached to the undertaking; a meeting is held every two months, when the purser presents his accounts, made up for that period, and, consequently, the shareholders are enabled to judge of the profitable nature or otherwise of the undertaking, before any extensive liabilities are incurred; and any one feeling dissatisfied may, on paying his proportion of the debts due, "sign his name off the cost-book" as it is termed, and by which he ceases to be liable for any future costs.

Country—The strata or rock through which the vein or lode traverses.

Course of ore—A portion of the lode containing a regular vein of ore.

Cover—The box into which the ore is removed from the rock; also the place at the head of the trunk, in which the slimes are by agitation mechanically suspended in water, in the process of trunking.

Crib, or Curb—A circular frame of wood, screwed together, as a foundation for bucking or pulverising ore in a shaft.

Creases—Divisions of buddled work.

Cross-course—A lode or vein which intersects or crosses a lode at various angles, and generally throws the lode out of its regular course.

Cross-course spar—Radiated quartz.

Cross-cut—A level driven at right angles to the direction of the lode.

Crop—The best ore.

Crushing—Grinding the ores without water.

Cuneiform—Wedge shaped.

Cube—A solid figure, contained under six equal squares.

Cupelo—A small furnace.

Cut—To intersect by driving, sinking, or rising.

Costeaning—Discovering lodes by sinking pits in their vicinity, and driving transversely to their supposed direction.

Chats—Small heaps of ore.

Cofering—Securing the shaft from the influx of water by ramming in clay, &c.

Collar of a shaft—The timber by which its upper parts are kept from falling together.

Collar launder—The pipe or gutter at the top of a lift of pumps through which the water is conveyed to the cistern.

Connection or Connecting rods—The larger rods which are attached to the engine beam.

Core—Miners usually work but six hours at a time, and, consequently, four pairs of men are required for the whole time—"forenoon core," from 6 A. M. to noon —"afternoon core," from noon to 6 P. M.—"first core by night," from 6 P. M. to midnight—and "last core by night," from midnight to 6 A. M.

Dam—Choke damp, foul air.

Deads—Attle or rubbish.

Dead ground—A portion of the lode in which there is no ore.

Dean—The end of a level or cross-cut.

Dialling—Surveying for the purpose of planning.

Dileuing or Terluing—Washing ores supported on a hair-bottomed sieve in water.

Dippa—A small pit.

Dish—That portion of the produce of a mine which is paid to the landowner or lord.

Dissueing—Is when the lode is small and rich, to break down the strata from one of its walls, by which means it can afterwards be taken away without being deteriorated, and without waste.

Dowsing-rod—The hazel rod of divination, by which some pretend to discover lodes.

Dropper—A branch when it leaves the main lode.

Draft engine—An engine used for pumping.

Dredging ore—A stone impregnated, or traversed by minute veins of ore.

Driving—Digging horizontally.

Drift—The excavation made for a road under-ground.
Dressers—Cleaners of the ore.
Durns—A frame of timber with boards placed behind it, to keep open the ground in shafts, levels, &c.
Dzhu or hulk—To dig away a portion of the rock, &c., on one side of the end, that the blast may be more efficient.
Elvan—Porphyry, clay, stone.
End—The further extent of a level or cross-cut.
Engineer—The superintendent of the machinery.
Engine-man—Man who attends to, and works the engine.
Engine-shaft—The pit or shaft by which the water is drawn by the engine from the lower parts of the mine, to the adit or surface.
Fast—The firm rock beneath the diluvium.
Fang—A niche cut in the side of an adit, or shaft, to serve as an air course; sometimes a main of wood pipes is denominated a fanging.
Feeder—A branch when it falls into the lode.
Flang—A two-pointed pick.
Flat rods—Rods for communicating motion from the engine horizontally.
Floran tin—Tin ore scarcely perceptible in the stone; tin ore stamped very small. —(*Pryce.*)
Flookan—A soft clayey substance, which is generally found to accompany the cross-courses and slides, and occasionally the lodes themselves; but when applied to a vein, means a cross vein or course composed of clay.
Fluke—The head of the charger; an instrument used for cleansing the hole previously to blasting.
Footwall—Is the wall under the lode; it is sometimes also called the underlaying wall.
Footway—The ladders by which the workmen ascend and descend.
Forcepiece—A piece of timber put in a level, shaft, &c., in a diagonal position, for keeping the ground open.
Fork—"Water in fork," water all drawn out; the bottom of the engine-shaft.
Furnace—The place in which the ore is placed for the purpose of smelting or reduction.
Gad—A pointed wedge of a peculiar form, having its sides of a parabolic figure.
Glist—Mica.
Good levels—Levels driven nearly horizontal.
Gossan—Oxide of iron and quartz generally occurring in lodes at shallow depths.
Grass—The surface.
Grain tin—Crystaline tin ore; metallic tin smelted with charcoal.
Grate—Stamps grate; a metallic plate pierced with small holes; it is attached to the stamps, and through the holes the stamped ores escape.
Griddle or riddle—A sieve.
Grinder—Machinery for crushing the ores between iron cylinders or barrels.
Growan—Decomposed granite; but sometimes applied to the solid rock.
Ground—The country; the stratum in which the lode is found.
Gulph of ore—A very large deposit of ore in a lode.
Gunnies—Levels or workings.
Gurt—A gutter; a channel for water.
Halvanner—The dresser of, or operator on, the halvans.
Halvans—The ores which are not sufficiently rich to be offered for sale until much of the impurities with which they are mixed is removed by operations in water.
Hanging wall—The wall or side over the lode.
Hauling—Drawing ore or attle out of the mine.
Head sword—The water running through the adit.
Heave—The horizontal dislocation which occurs when one lode is intersected by another having a different direction. A right or left hand heave is when the part of the intersected lode on the opposite side of the traversing vein is found by turning either to the right or left.
Hook handles—The handles by which a windlass is worked.
Horse—The dead ground included between two branches of a lode, at the point of their separation.
House of water—A vugh or space, whether artificially excavated or not, filled with water.
Horse arm—The part of a horse whim to which the horses are attached.
H Piece—See *Aitch piece.*
Hutch—Cistern or box.
Irestone—Hard clay slate, hornblende, hornblende slate, hornstone.

Jigger—Cleaner of the ores.

Jigging—Separating the ore with a griddle or wire-bottomed sieve, the heavier substance passing through to the bottom or lower part of the sieve; the lighter substances remaining on the upper part are put by for halvans.

Junction—Applied to where veins unite.

Jumper—A long borer, worked by one person.

Keeve—A large vat.

Kibble—A bucket usually made of iron, in which the ores, &c., are drawn to the surface.

Kibble filler—Man who sends up work, &c., to the surface.

Killas—Clay slate.

Lander—Man who attends at mouth of shaft to receive the kibble in which ores, rubbish, &c., are brought to the surface.

Lappior—The dresser of the leavings.

Laths—The boards which are put behind and supported by the "durns."

Launders—Tubes or gutters for the conveyance of water; their form that of a long box, wanting the upper side and both ends.

Leader of the lode—A branch or small vein; part of the main lode.

Learies—Empty places; old workings or vughs.

Leat—A watercourse.—(*Pryce.*)

Leavings—The ores which are left after the "crop" is taken out.

Levels—Galleries driven on the lode usually at ten, twenty, thirty, &c., fathoms below the adit level.

Lifters—Wood beams, to which the iron heads of a stamping mill are fastened.

Lock piece—A piece of timber used in supporting the workings.

Lode—A regular vein producing or affording any kind of metal.

Loobs—Slime containing ore.

Lost levels—Levels which are not driven horizontally.

Machine whim—A rotary steam-engine employed for winding.

Mallet—An instrument used with the borer.

Material man—One who delivers out, and has care of the materials.

Meat earth—The vegetable mould.

Mock lead—Blende.

Moorstone—Granite.

Mundic—Iron pyrites.

Needle or Nail—A long taper piece of copper or iron with a copper point used when stamping the hole for blasting, to make, by its withdrawal, an aperture for the insertion of the rush or train.

Owner's account men—Workmen paid at so much per day.

Pack—To occasion the speedy subsidence of the ore in the process of tossing or chimming, by beating the keeve in which it is performed by a hammer.

Pair—Gang or party of men.

Parcel—A heap of ore dressed and ready for sale.

Pass—An opening left for letting down stuff to the level.

Peach—Chlorite.

Pedn cairn—A bunch of ore at a distance from the lode.

Pick—An instrument of common use, as well in agriculture as in mining.

Picker or Poker—A hand chisel for dzhuing, which is held in one hand, and struck with a hammer.

Pillar—A piece of ground left to support the roof or hanging wall.

Pitch—Limits of the piece of ground set to tributers.

Pitch bag—A bag covered with pitch, into which powder is put (previously to its being introduced into a damp hole) that it may be protected from moisture.

Pitman—One employed to look after the lifts of pumps and the drainage.

Pitwork—The pumps and other apparatus of the engine-shaft.

Plat—Ground taken away to contain any ores or deads.

Plunger—The piston or forcer of a forcing pump.

Plunger lift—The set of pipes attached to a forcing pump.

Point of the horse—The spot where the vein is divided into two or more branches.

Pol-roz—Pronounced polrose; the pit underneath a water wheel.

Pot-grown—Soft decomposed granite.

Prian—Soft white clay, esteemed a favorable sign when found in a lode.

Pril—A solid piece of virgin metal, or the button from an assay.

Produce—Fine copper contained in 100 parts of ore.

Purser—The cashier or paymaster at the mines.

Quere—A small cavity or fissure.

Rack—An inclined frame on which the ores and slime are washed and separated.

Racking—Is a process of separating small ore from the earthy particles by means of an inclined wood frame; the impurities being washed off, and the ore remaining near the head of the rack taken from thence, undergoes tossing.

Reed or spire—Gorse, or other tubular vegetable, into which gunpowder is put to convey a train from the snoff to the charge, the reed being put into the aperture made by the needle.

Refining—Separating the ores.

Relief—When one workman of the same pair changes core, or takes the place of another.

Riddle or griddle—A sieve.

Rising—Digging upwards.

Row—Large stones, rough.

Rullers—The persons who work the wheel barrows underground.

Run—When excavations fall together.

Run of a lode—Its direction.

Rush—Used for the same purposes as the reed and spire.

Scal—A shale or portion of earth, rock, &c., which separates and falls from the main body.

Scovan lode—A lode having no gossan on its back or near the surface.

Scraper—A piece of iron used to take out the pulverised matter which remains in the hole when bored, previously to blasting.

Seam—A horse load.

Set—A number of mines taken upon lease.

Set of timber—A frame complete to support each side of the vein, level, or shaft.

Set off—The part of a connecting rod to which the bucket rod is attached.

Shaft—A sinking or pit either on the lode or through the country.

Shaking—Washing the ores.

Shammel—When ore or water is lifted part of the required height by one machine or person, and part by another.

Shears—Two very high pieces of wood placed in a vertical position on each side of a shaft and united at the top, over which by means of a pulley passes the capstan rope. This is for the convenience of lifting out or lowering into the shaft, timber, or other things of great length.

Shelf—The firm rock.

Shieve—The pully over which the whim rope passes.

Shoding—Tracing round stones from the vale to the lode whence they were torn by the deluge, or by some convulsion of nature.

Shooting—Shutting or blasting; fracturing and separating by the use of gunpowder.

Sinking—Digging downwards.

Skimpings—Skimmings of the light ores, &c., in the dressing process.

Slide—A vein of clay which, intersecting a lode, occasions a vertical dislocation.

Slimes—Mud containing metallic ores; mud or earthy particles mixed with the ore.

Smelting—Reducing the ores by means of fire.

Snoff or match—A substance, frequently brown paper, or other slowly combustible substance, which is ignited at one end, the other being in contact with the rush or train in blasting; the slow combustion is to permit the escape of the laborers.

Sollar—A small platform at the end of a certain number of ladders.

Spalling—The breaking up into small pieces, for the sake of easily separating the ore from the rock, after which it undergoes the process of cobbing.

Span Beam—The horizontal beam passing over the whim in which the upper pivot of the perpendicular axis moves.

Stamps—Machinery for crushing the ores with the presence of water.

Stamp head—The iron weight or head connected with the stamps.

Standard—The price of fine copper.

Stannary laws—Regulations for the management, &c., of tinners, administered by equity judges resident in Cornwall and Devon.

Stem—A day's work.

Stope—A horizontal bed; *to stope*, to excavate horizontally, layer after layer.

Spar—Quartz.

Spend—To break ground; to work away.

Squat of ore—See *Bunch*.

Strake—A launder, or box of wood without ends, in which the process of washing or tying is performed.

Strapping plates—The iron plates by which the connection rods are fastened to each other.

Stream tin—Tin ore found in the form of pebbles, most frequently in vales.

Streamers—The persons who work in search of stream tin.

String—A small vein.

Stuff—Attle or rubbish.

Stull—Timber placed in the backs of levels, and covered with boards or small poles to support rubbish.

Sturt—When a tributer takes a pitch at a high tribute, and cuts a course of ore, he sometimes gets two, three, to five hundred pounds in two months; this great wages is called a sturt.

Sump—A pit; the bottom of the engine-shaft.

Sump-shaft—The engine-shaft.

Sumpmen—The pitman's assistants; men who attend to the machinery in the engine-shaft.

Tackle—Windlass, rope, and kibble.

Tamping—The material, usually soft stone, placed on the gunpowder, in order to confine its force, which would otherwise pass up the hole; also, the process of placing the material.

Tamping iron or bar—Tool used for beating down the earthy substance on the charge used in blasting.

Team—To lade water in bowls.

Thrown—either up or down—Is when a slide intersects a lode, the dislocation being shown by a transverse section—*Thrown up*, is when the undiscovered portion of the intersected lode is found to have been apparently lengthened—*Thrown down*, is the reverse.

Ticketings—The sale of ores.

Timber man—The man employed in placing supports of timber in the interior of the mine.

Tollar—A person who periodically examines the limits of ground producing tin ore belonging to himself or (the lord) his employer.

Ton—The ton varies in different districts: the common ton is 20 cwt. of 112 lbs. or 2,240 lbs. In Cornwall, the mining ton is 21 cwt. of 112 lbs. or 2,352 lbs. Tin is sold in Cornwall by the 1,000 lbs. and not by the ton.

Tossing or Tozing—A process consisting in suspending the ores by violent agitation in water, their subsidence being accelerated by packing—the lighter and worthless matter remaining uppermost.

Trade—Attle or rubbish.

Tram carriage—The carriage (usually made of iron) used on a tram-road.

Tram road—Iron railroad way.

Treloobing—See Tossing.

Tribute—Proportion of the ore which the work-man (tributer) has for his labor.

Tributers—Men whose pay is a certain proportion of the ore or value of the ores they raise.

Tribute pitches—The limited portions of a lode which are set to "a pair" of tributers, beyond which they are not for the time being permitted to work.

Tunnel head—The top of a furnace, at which the materials are put in.

Turned house—A term used when a level, in following branches of ore, is turned out of the original direction.

Trunk—A long narrow cistern or pit, in which the ore and slime which are mixed are separated by the subsidence of the former, and the washing off the impurities—the inclined box in which the ore and slimy impurities are separated in the process of trunking.

Trunking—Process of extracting ores from the slimes—subsequently the ores undergo the processes of racking and tossing.

Tummals—A great quantity; a heap.

Tut work—Work in which the laborer earns in proportion to the amount of his labor; being paid for driving at a certain price per fathom.

Tuyere—The aperture through which the air or blast is introduced into the furnace.

Tying—Washing.

Underlayer—A perpendicular shaft, sunk to cut the lode at any required depth.

Underlayshaft—Shaft sunk on the course of the lode.

Van—To wash and cleanse a small portion of ore on a shovel.

Vugh or vogle—A cavity.

Washing—The ore undergoes occasionally two or three washings; the first process being that of washing the slime and earthy particles from the rougher and large stones of ore.

Water in fork—When all the water is extracted.

Well—The lower part of a furnace into which the metal falls.
Whim—A machine worked by horse, steam, or water. for raising ores, &c.
Whim driver—Man who attends to the horse in the whim.
Whim rope or chain—The rope or chain by which the kibble is attached to the winding engine or whim.
Whim shaft—The shaft by which the stuff is drawn out of the mine by horse or steam whim.
Whip and derry—A kibble drawn to the surface by a horse, the rope attaching one to the other simply passing over a pulley.
Winch or winze—Contraction of windlass; the wheel and axle frequently used for drawing water, &c., in a kibble by a rope.
Windbore—The lowest pump in which there are holes to admit water.
Winding engine—One used to draw up ore, attle, &c.
Winze—A sinking on the lode communicating one level with another, for proving the lode, or for ventilating such drivings.
Work—Ores before they are cleansed or dressed.
Working barrel—The pump in which the piston works.
Working big—Sufficiently large for a man to work in.
Zawn—A cavern.
Zighyr—When a small slow stream of water issues through a cranny it is said to zighyr or sigger.—(*Pryce.*)

DERBYSHIRE MINING TERMS.

Adit—A horizontal level taken up at the foot of a hill, and either driven on the lode or to intersect it, for unwatering or draining the mine at that level, and also occasionally used for bringing out the ores. The top adit is the adit first driven, deep adit the lowest adit driven, air adit is the adit driven purposely for ventilating the mine.
Arched—The roads in a mine when built with stones or bricks are generally arched; level drifts and horse roads, either when cut in coal or in other strata, are formed arch fashion in the cutting for better security.
Bank or benk—The face of the (coal) works or place where the miners are turning out the coal, sometimes called benk face.
Bar master—An officer who superintends the lead mines.
Bar mote—A hall or court in which trials relative to lead mines are held.
Bassit—The outcrop of the strata, when a substance as coal appears at the surface it is said to bassit; also sometimes used to signify the upper end of the works, as the bassit or upper end.
Bearer or biard—A large piece of timber to support the cistern and pumps in an engine-shaft.
Balland—Dusty lead ore.
Belt—A strap to which is attached a chain, by which coal miners draw the loaded corves of coal.
Bender—A piece of iron attached to trunks or barrels to which the pit rope is affixed.
Bina—Indurate clay; a name given by miners to any indurate argillaceous substance.
Binghole—A hole through which the ore is thrown.
Bingplace—The place where the ore is laid ready for smelting and measuring.
Boring bit—A piece of steel placed at the end of the borer.
Blast—The air introduced into a furnace.
Blasting—A hole made with a borer in which gunpowder is introduced, which being confined, and set fire to by a match, forces off a portion of the rock or lode—the process is called blasting.
Board, or *Board gate*—An adit is driven board when it runs in a transverse direction to the grain or face of the coal.
Borer, Augur, or Drill—A round piece of iron, the one end steeled.
Bow—See Bender.
Bowse—Lead ore as cut from the vein.
Breast—The face of the (coal) workings.
Brettis (*in coal mines*)—A quantity of wood packed together, and the interstices filled up with slack or rubbish.
Brettis way (*ditto*)—A way or road in the mine supported by brettises, built up on each side after the coal has been wrought out.
Bucker—A flat piece of iron with a wooden handle used for breaking or crushing the ore by hand.

Bucklers, or Tacklers—Small chains put round the coals, when loaded in corves, to prevent them from falling off.

Buddle—A frame made of wood and filled with water in which the lead ore is washed.

Budling—Washing inferior ore lead to free it from extraneous matter.

Bule—A piece of wrought iron to put round buckets or clack doors on large pumps, to hold them in their respective places.

Bunding—Wood placed on which the refuse cuttings or deads are thrown.

Butty—In collieries a person who contracts to raise coal by weight or measure.

Cank—Whimstone.

Cap or Lid—A flat piece of wood placed between the top of the punch and the roof of the mine.

Cat dirt—A substance also called toadstone, being sometimes clay, coal, and pyrites of iron; at others, a kind of earthy scoria not unlike lava.

Chair—Used in drawing up ore or coal.

Chisel—See Drill.

Churndrill—A large drill from four to six feet long, commonly made with a chisel point at each end.

Cleet—A wedge.

Clivis—A hook with a spring to prevent its unfastening.

Coesteads—A small building.

Cofer—Cofering is beating a quantity of clay round the bricking in shaft to prevent the water coming through, and to hold it back in the strata.

Colliery bailiff—Superintendent of the colliery.

Cope—To agree to get lead ore at a fixed sum per dish or load, or other measure.

Coper—One who agrees to get lead ore by bargain.

Corf—A square frame of wood to load coals on; a kind of sledge used to carry ore from the miners at work to the shaft bottom.

Creep—The weight of the incumbent strata after the coal has been partially worked out.

Crib, or curb—A circular frame of wood, either pinned or screwed together, to serve as a foundation for the bricking in a shaft.

Cross-cuts—Are lodes or levels driven in a diametrical direction, across the range of the vein.

Crow-bar—A lever from six to eight feet long.

Cupelo—A small furnace, worked by blast.

Curb—See Crib.

Cutting—An air course set up at either end of the work after the coal has been wrought out.

Crosses and holes—When a person discovers a vein, and has no means to possess it for want of stowces, he marks the ground with crosses and holes, by which means he possesses it until he can procure stowces.

Dam—Dams are made for various purposes underground, either for holding back water or noxious vapors, such as choke or fire damp. They are generally built either with sand or clay.

Dan—A square frame of wood to draw coals from the work to the main roads underground.

Deads—Cuttings of stone of no use, attle or rubbish.

Deep level—The watercourse leading to the engine-shaft, being always the deepest adit in the mine.

Dial—A compass used to take bearings in mines.

Dialling—Taking the different bearings of the various ways, gates, &c., in a mine; surveying.

Dish—A measure containing fifteen pints Winchester measure.

Door in a mine—Is sometimes used to open and shut, to increase the circulation of air.

Dresser—See Loading pick.

Drift—The excavation made for a road underground.

Drill—An instrument for boring shot and other holes.

Driving—Cutting and blasting horizontally, applied to making a level or adit.

End—An adit is said to be driven end when it is in a line with the grain of the coal.

Ending—An adit driven in a direction with the grain of the coal.

Elve—The shaft or handle of a pick.

Face—The face of the coal is at right angles with the grain.

Fang—A niche cut in the side of an adit or shaft to serve as an air course; sometimes a main of wood pipes is denominated a fanging.

Fausted—Refuse lead ore requiring to be dressed finer.

Fault—An intersection of the strata.

Feigh—The refuse washed from the lead ore.

Flat—Flat work, &c., when a vein, &c., is horizontal.

Forks—Pieces of wood used to keep the side up in soft places.

Foundermere—The first thirty-two yards of ground worked.

Foundershaft—The first shaft that is sunk.

Forefield—The face or extent of the workings.

Forefield end—The farthest extremity of the workings.

Freeing—Entering a mine or vein in the bar-master's book.

Fuzze—Straws or hollow briars, reeds, &c., filled with powder.

Gallery—A drift or level.

Gate—Road or way underground; it has various uses, either for air, water, or for bringing out the mine, coal, &c.

Gin—The machine by which the coal or ore is raised from the mine.

Gobbing—The rubbish remaining after the coal has been extracted.

Grove—A mine.

Gingoni—Walling up a shaft instead of timbering to keep the loose earth from falling.

Hade—The underlay or inclination of the vein.

Hadings—When some parts of the vein incline and others are perpendicular.

Hangbench—Part of the stowces.

Hanging side—The wall or side over the vein, or to which it hangs.

Horn—A line running horn is at an angle of 45 deg. with the face of the coal.

Jackhead pit—A well sunk inside the mine for various purposes.

Jackhead pump—The house water pump of an engine is sometimes so called.

Jig pin—A pin used to stop the machine in drawing when necessary.

Judge—A staff to measure underground work with—viz. the holeing in coal work.

Jumper—A large borer, an iron instrument worked by hand, and steeled at each end like chisel bits.

Kevil—A sparry substance found in the vein composed of calcareous spar, fluor, and barytes.

Kibble—A bucket used for drawing up lead ore out of the mine.

Kit—A wood vessel of any size.

Knits—Small particles of lead ore.

Knockings—Lead ore with spar as cut from the vein.

Knockstone—A stone used to break the lead ore on, but sometimes it is a piece of cast-iron.

Leap—The vein is said to leap when a substance intersects it, and it is found again a few feet from the perpendicular.

Leadings—Small sparry veins in the rock.

Level—An adit, gallery, or sough; generally, the main water-course in a mine.

Lid—See Cap.

Limp—An iron plate used to strike the refuse from the sieve in washing lead ore.

Loading pick—A pick made purposely to cleave or rive up coals and prepare them for laying on the corves.

Loch—A cavity in a vein.

Lot—A certain proportion taken as dues for the lord of the manor, or owner of the mine.

Maul—A large hammer.

Maundrill—A pick for various purposes, but generally used to undermine.

Mear—Thirty-two yards of ground on the vein.

Needle, or pricker—A thin rod of iron put in shot holes, while they are rammed up, and which being then drawn out leaves a hole into which the match is introduced for setting fire to the charge.

Noger—A jumper or borer; a drill.

Nogs—Square pieces of wood which are piled on each other to support the roof of a coal mine.

Noper—See Loading pick.

Old man—Places worked centuries ago, or in former ages.

O'erlayer—A piece of wood on which the sieve is placed after washing the ore in a vat.

Opens—Large caverns.

Open cast—When a vein is worked open from the *day* or surface.

Ore—The mineral as produced in a mine.

Pack—A quantity of materials, either wood or coals, &c., piled up to support the roof, or for other purposes.

Pee—A piece of lead ore.

Pillar—A support for the roof. of timber, stone, or other material.
Pipe—A vein running unlike a rake, having a rock roof and sole.
Plumb—A line and lead to measure with.
Poling—A plank or piece of wood to prevent earth or stone from falling.
Possession—When stowces or wooden frames are placed on a vein it is said to be in possession.
Post—A pillar of coal or other strata left.
Pricker—A thin piece of iron used to make a hole for the fuze or match to fire a blast.
Pringap—A variable distance between two possessions.
Punch—A piece of timber used as a support for the roof.
Rake—An oblique vein.
Ratchell—Loose stones.
Rib—A pillar of coal left as a support for the roof.
Ricket—See Fang.
Rider—A rocky substance which divides the vein.
Ringer—A crowbar.
Rising—A man working above his head in the roof is said to be rising.
Roof—The part above the miner's head; that part of the strata lying immediately upon the coal.
Rubble—See Ratchell.
Run—When the earth falls and fills up the shafts or works, it is said to run.
Safety fuse—An excellent invention, by Messrs. Bickford, Smith, & Davy, of Camborne, for the safe and certain blasting of rocks in mines and quarries.
Scaffold—In a mine a platform made, where some miners work above the heads of others.
Scouring bit—A bit attached to the end of boring rods for the purpose of extracting the rubbish.
Scraper—An instrument to extract the pulverised rock, &c., from shot holes when boring.
Scrin—A small vein.
Seat or sole—The floor or bottom of the mine.
Shaft—A pit, the perpendicular entrance to the mine.
Shakes—Fissures in the earth.
Shift—The time a miner works for one day.
Shot—Blasting.
Sinking—Working deeper or downwards.
Skep or skip—A square box (usually wrought iron) in which the coals are sent up to the pit's mouth.
Sled—A sledge to draw ore without wheels.
Slipes—Flat pieces of iron for the corves to slide on.
Slit—A communication between two adits.
Smelting—Reducing the ore to metal.
Smitham—Small lead ore dust.
Smut—Decomposed dark earthy substance, or coal decomposed by the air at the surface of the earth.
Sole—The seat or bottom of the mine, applied to horizontal veins or beds.
Sole tree—A piece of wood belonging to stowces to draw ore up from the mine.
Sough—An adit or level for carrying off the water.
Spanner—An instrument to turn screws with.
Spindle—A part of the drawing stowces.
Stays—Pieces of wood to secure the pumps in the engine-shaft.
Stemmer—A piece of iron with which clay is rammed into the shot holes to make them water tight.
Stemples—Wood placed to go up and down the mine instead of steps.
Stickings—Narrow veins of ore.
Stope—A piece of mineral ground to be worked.
Stoping—Cutting mineral ground with a pick; working downwards.
Stopping—A dam of bricks or clay to turn the course of the air.
Stowce—Drawing stowce; a small windlass.
Strings—Small veins of ore.
Stowces—Pieces of wood of particular forms and constructions placed together, by which the possession of mines is marked; a pair of stowces possess a mear of ground.
Sump—A shaft under ground, a well or lodge for water.
Swallows—Caverns or openings where the water loses itself.
Tacklers—Small chains to put round the loaded corves.

Thurl—A long adit in a coal pit.
Thurst—The ruin of the incumbent strata after the pillars and stalls are wrought out.
Trogues—Wooden drains like troughs.
Troubles—Faults or interruptions in the stratum.
Trunks—Wooden spouts to convey wind or water; small boxes in which rubbish or dirt is sent up out of the mine.
Tub—A cast-iron cylinder put in the shaft instead of bricking, for the purpose of beating out the water and making it rise to a level.
Tugs—Hoops of iron fastened on the corves to which the tacklers are affixed.
Turntree—A part of the drawing stowces or windlass.
Underlay—When a vein hides or inclines from a perpendicular line, it is said to underlay.
Vein—Any substance different from the rock; a rake vein is oblique; a pipe vein nearly horizontal.
Vat—A wooden tub used to wash ore and mineral substances in.
Wash hole—Where the refuse is thrown.
Walling—When the roads in the mine are made with stone it is called walling. The side of the mine or gangart is frequently called the wall.
Wastes—Vacant places left in the gobbing, on each side of which the rubbish is packed up for the better support of the roof.
Water holes—Places where the water stands.
Weigh board—Clay intersecting the vein.
Wedge—An iron tool to get ore, split rocks, &c.
Whim—An engine or machine to draw ore, &c., worked by horses.
Wind way—A passage left purposely for air.
Wind bore—The bottom pipe in a lift of pumps.
Wind holes—Shafts or sumps sunk to convey wind or air.
Windlass—A machine used to draw up ore, &c.—See Stowces, by which name it is commonly called.
Windless—A place in a mine where the air is bad or short, is said to be windless or airless.
Yokings—Pieces of wood ascertaining possession; stowces.

SPANISH MINING TERMS.

Abra—A fissure, a considerable opening or cavity in the mountain, rock, or lode.
Abronzado—Yellow copper ore, sulphuret of copper.
Acarreadores—Wood carriers.
Acero—Steel.
Achicar—To decrease, to diminish; applied to the diminution of water in any of the workings, lowering the water in the shafts, &c.
Achicadores—Workmen employed in removing the water in *botas.*
Acuña—Die for coining.
Acuñacion—Coining.
Acuñador—One who coins.
Acuñar—To coin.
Ademador—A mining carpenter; a timber man.
Ademar—To timber.
Ademe—Timber work for supporting and securing the works of the mine.
Adobes—Unburnt bricks made of straw, earth, and dung, dried in the sun.
Administrador—Superintendent.
Administracion—Administration, management.
Afinacion—Refining.
Agata—Agate.
Aguafuerte—Aquafortis, nitrous, or nitric acid.
Ahondar—To sink, to deepen.
Ahonde—Sinking or driving downwards.
Alabastro—Alabaster.
Albañil—Mason, bricklayer.
Albaradon—A dyke.
Albayalde—White lead.
Albergue—A natural hollow, a den.
Alcohol—Galena, sulphuret of lead.
Alcribis o Tovera—The tuyere of a smelting furnace.
Alear—To alloy metals.
Aleacion—The art of alloying metals.
Alhondiga—Corn market or public granary.

Alimentos—In mining, an allowance to mine owners, as subsistence, until their mines become profitable.
Almacen—A store-house, store-room, ware-house.
Almadeneta—A stamp head.
Almagra—Ruddle, red ochre.
Almud—12th part of a fanega.
Alquifol—Galena.
Alquilar—To hire.
Alto—The upper part.
Alumbre—Alum.
Ambar—Amber.
Amatista—Amethyst.
Amianto—Amianthus.
Amoldar—To mould.
Amonedar—To coin.
Amparo—The maintenance of the legal right of ownership by continued possession. In mining, this can only be preserved by keeping a certain number of men at work at certain periods, as determined by the mining code.
Anchura—Width, roominess.
Angulo—An angle, a corner.
Antimonio—Antimony.
Aparejo—A tackle, a block and fall, an apparatus, a set of harness for beasts of burden or draft; a pack saddle.
Apartado—Establishment for parting silver and gold.
Aperos—Utensils; also materials, such as gun powder and paper for blasting, &c.
A pique—*Trabajar a pique.* Digging downwards in a vertical direction.
Apolvillados—Rich ores.
Apuradores—Men who rewash the earth from the tinas.
Arcilla—Clay.
Arena—Sand.
Arenilla—Fine sand.
Arrastrar—Applied to where veins unite and form one; to drag.
Arrastre—Mill for grinding ores, employed in the process of amalgamation of silver ores and of gold.
Arreador—Horse driver for malacates.
Arroba—25 lbs. Spanish weight.
Arriero—A muleteer.
Arsenico—Arsenic.
Asbesto—Asbestus.
Aserrador—A sawyer.
Aserrar—To saw.
Asfalto—Asphaltum.
Astillero—Open forest, pasture for mules, &c.
Atacadera—A rammer.
Atacador—Rod for ramming in the charges for blasting.
Atajador—A boy who attends the horses and mules.
Atajo abierto—Applied to a mine when worked in the manner of a quarry, or by an open cut in a rock or mountain.
Atargea—Water-course of masonry.
Atecas—Laborers who collect the water in buckets from the planes of the mines, in order to pass it off by the shafts; also, men who fill the skins in the shafts with water, mud, &c.
Atierres—Attle, rubbish; in the mine, earth preventing the continuation of the work.
Atisador—A stoker, man who attends the furnace.
Audiencia—Principal tribunal of justice.
Aviado—The mine owner supplied with funds for working his mines.
Aviador—He who supplies funds for working mines.
Avio—Funds advanced for working mines.
Avios—Implements.
Ayudante—Assistant.
Azabache—Jet.
Azanca—A leat.
Azarcon—Red lead.
Azogue—Quicksilver; silver ore adapted for amalgamation.
Azogue apolvillado—Very good ore for ditto.
Azogue commune—Common ore for ditto.

Azogue ordinario—Ordinary ore for amalgamation.
Azogue razonable—Middling ore for ditto.
Azogue en caldo—Quicksilver.
Azogueria—The ware-room, in which quicksilver is kept in store.
Azoguero—An amalgamator; person who superintends the process of amalgamation.
Azufre—Sulphur.
Azufre vivo—Native sulphur.
Bancos—Rocks, which intercept the vein, or cause it to take a different direction.
Banquillos—Stools on which the marquetas are placed.
Baño—The last portion of quicksilver applied to a torta.
Barquina—A large furnace.
Barquines—Forge bellows.
Barra—A bar, an iron crow; equal shares into which the interest in a mine is divided. usually 24 in number.
Barra de plata—A bar of silver, usually about 135 marcs, or 1,080 ounces.
Barranca—A ravine.
Barrena—A drill or borer used in blasting.
Barrenadores—Miners who work with the borer and mallet.
Barrenar—To bore.
Barrenero—A boy who attends with the boring tools.
Barrenos—Holes made for blasting.
Barreta—A miner's bar or crow.
Barreteros—Miners who work with crow bars, wedges, or picks.
Barro—Clay, loam, mud.
Basalto—Basalt.
Batea or *Apuradera*—A bowl used in re-washing.
Baxo—Beneath, low, lower part.
Beneficiar—To extract the metal from the ore; to dress ore.
Beneficio—Making the metallic contents of the ore available by reduction.
Beneficio de cazo—Reduction of ore by amalgamation, conducted in a copper pan over a fire; hot amalgamation.
Beneficio de hierro—Reduction of ore by amalgamation, with the addition of fragments of iron.
Beneficio de patio—Reduction of ore by amalgamation, in sheds or open court-yards.
Beneficio de pella de plata—Applied when a portion of amalgam of silver is added to the mass under amalgamation.
Beneficio de la colpa—A method of amalgamation, in which, instead of *magistral*, *colpa* (colcothar) is used.
Beneficio por fuego—Reduction of ore by smelting.
Berilo—Beryl.
Bigorneta—A small anvil.
Bigornia—An anvil.
Bismut—Bismuth.
Blandura—Soft, crumbly ground.
Blenda—Blende, sulphuret of zinc.
Boca—Mouth, entrance, or pit of a mine; first opening made in the vein.
Boca mejora—A shaft or boca to communicate with the entrance of the vein to facilitate the workings.
Bochorno—Vapor, or foul air; want of ventilation; suffocating heat.
Boletas—Tickets of sale of ores; cheque tickets; account of charges, and produce of one amalgamation operation.
Bolsa—A purse; sometimes applied to a bunch of good ore of the supposed shape of a full purse or bag.
Bomba—A pump.
Bonanza—Prosperity; fine weather. A mine in *bonanza* is in a prosperous state; stopping costs, yielding profit.
Bordes—Border; ore left untouched by previous working in an old mine work.
Bordeta—A small pillar.
Borrasca—Adversity; foul weather. A mine in *borrasca* is in an unproductive state; does not stop costs.
Bota—A leather bag or sack, made of one or more ox skins, in which water is lifted in the mines.
Bota chica—Small leather bag.
Bota grande—Sack made of 2 or 2½ hides, used to extract water, and worked by horse whims.

Botilla de burro—Sack, or bag, made of one neat hide, to extract water, and worked by a burro or hand whim.
Botilla de lomo—Small sack made of one-third of a hide, to carry water out of small sinkings on men's backs.
Boveda—Vault, arch.
Braceage—Brassage in coining.
Broculas—Drills.
Bronce—Brass; gun metal; iron pyrites.
Buytron—Furnace for smelting ores.
Burilada—A chip taken from a mass of silver to try whether it be standard.
Burro—A hand whim; a windlass.
Busca—(Search) The right to employ *buscones* frequently claimed by the administration and persons employed in mines.
Buscones—Tributors or miners who work on part proceeds; also, those who search for ores in a metalliferous district generally, or in a mine for such ores as may have been neglected, and left behind by others.
Caballerangos—Horsekeepers.
Caballitos—Men who carry the mining captains or others.
Caballo—A horse; a mass of the steril mountain rock immersed in the lode.
Caballo de tepatate—A mass of barren rock interposed in a vein.
Cadena—A chain.
Cajon—In Peru and Chili two montons of 32 quintals each, 64 quintals.
Cajon de granza—The pit to receive the crushed ore.
Cajonero—A lander, or one who receives the bota or manta at the shaft's mouth.
Cal—Lime.
Calde estaño—Calx of tin.
Calderas—Boilers.
Calentadura—The first heating of the furnace, or putting the furnace into blast.
Caliche—Calcareous matters; ores of a calcareous character.
Calicheros—Lime burners.
Calientes—Warm ores (in amalgamation) containing sulphuret of iron and copper, and no calcareous matter.
Caliza or Cal en piedra—Limestone.
Cal viva—Quicklime.
Campistas—Tributors.
Campo—A pitch, a working in possession of buscones, or allotted to the proprietors or others.
Canal—A spout, a canal.
Candallero—A socket deeper than the chumacera, and used for the same purpose.
Canella—Used to convey the fire to the charge for blasting.
Cañon—In a mine, a level, or horizontal gallery.
Caños—Pipes, tubes.
Cantera—A quarry.
Cantero—Stone mason; quarryman; a pitcher.
Caparossa—The person in charge of the sheds under which the tahonas are worked.
Capellinas—Large iron or copper bells, under which the quicksilver is separated from the silver in the amalgam by distillation.
Carbon—Coal; charcoal.
Carbon de leña—Charcoal.
Carbon de piedra or *Carbon de tierra*—Pit coal.
Carboneros—Carriers, makers, and sellers of charcoal.
Carcamo—The drain which carries off the earthy matter from the tinas when washing the amalgam.
Cardenillo—Verdegris.
Carena—An upright stanchion for supporting machinery.
Carga—380 lbs. Spanish; a mule load, varying in the different mining districts; a charge for blasting; a lode.
Carpintero—A carpenter.
Carilleros—Ore carriers.
Carretilla de mano—A wheel barrow.
Carrita—A wagon or cart.
Carritero—A waggoner.
Casa de moneda—The mint.
Cascajal—A gravel pit.
Cascajo—Gravel, rubbish.
Caso—A boiler used in hot amalgamation.

Castillo—The frame of the stamping machine.

Castina—Fluor, or flux.

Cata—A mine of no great depth, a pit made in quest of the vein, a mine denounced for trial.

Catear—To search for new mines.

Catero—A searcher for mines.

Caxa—Money chest, treasury.

Caxa del tiro—Reservoir at the bottom of the shaft, sump of the pit, that part of the pit below the deepest level driven from it.

Caxo—A measure of ore containing many quintals, but varying in bulk at different places; at Potosi, 5,000 lbs.; a hand-barrow.

Caxoneros—Landers at the mouth of a shaft.

Cebar—To feed; to supply a furnace with materials for smelting; to add quicksilver to a mass of ores under amalgamation.

Cebo—Priming, as of gunpowder; a feed, as oats for horses; second addition of quicksilver to the torta.

Cedazos—Sieves.

Cendrada—The bottom of the refining or cupelling furnaces, made of very fine earth and vegetable ashes which have been lixiviated; materials of which a cupelling test is made; the test itself.

Cendradilla ò Galeme—Cupelo.

Cerro—A mountain.

Cestas—Baskets.

Chapas—Iron blocks on which the stamps fall.

Charqueadores—Cart fillers.

Charqueo—Filling the baskets by hand.

Chichicles—Crystallised calcareous or other spar.

Chicuites—Baskets.

Chiflon—Trabajar chiflon. A phrase, meaning the work making way, both in length and depth.

Chino—Iron or copper pyrites.

Chumacera—An iron socket for the sockets of shafts.

Cielo—Roof of a work, an upward working. *Trabajar de cielo,* working at the roof or top of the vein.

Cilindro—A cylinder.

Cinabrio—Cinnabar, sulphuret of mercury.

Claro—An open space on the lode from which ore has been taken.

Clavos—Masses of native metal, bunches or masses of ore; nails.

Cobalto—Cobalt.

Cobre—Copper.

Cobre en roseta—Rose copper.

Cobriso—An inferior kind of copper ore.

Colero—Assistant of the underground captain in charge of the peonada, or account of the daily labor.

Cohete—A cartridge for blasting.

Collado—A hill.

Colorados—Ores colored with red oxide of iron.—(See *Pacos.*)

Comillo—A reverberatory furnace.

Comer los pilares—To take away the pillars of the lode which had been left during the previous working of the mine to support the roof, and consequently to abandon the mine.

Comerse los pilares—The same as *comer los pilares*, figuratively to abandon a mine.

Compromiso—A private engagement or undertaking; also a joint stock undertaking.

Conducta—A convoy or caravan, conveying the precious metals or coin over land.

Contra cielo—A rise or working upwards.

Contra mina—A work of communication between two mines; also an adit.

Convenio—A legal agreement.

Contra tiro—Auxiliary pit contiguous to a main pit or shaft, to serve as a footway, or for ventilation.

Copola—A cupelling furnace.

Copos or *Paxillas*—In amalgamation, little globules into which the quicksilver forms, when the process is too quick.

Coral—Copper.

Cortar pilar—To complete the pillar, and make a cross passage, and to form a landing-place.

Cortar las sogas—To abandon a mine; *lit.* to cut the ropes.

Costadores—Wood cutters.

Costal—Sack for ore, made of the *pita* or thread of the aloe; a rammer or beetle.

Cras—An iron cage or frame used in smelting.

Creston—Out-cropping of a lode; the crest of a lode appearing above the surface of the ground.

Criadero—A spot which is metalliferous; a spot, a district, a mountain, a rock where ores are supposed to grow.

Criba—Perforated leather, through which the stamped ore falls into a pit.

Crisolito—Chrysolite.

Cristal—Crystal.

Cristal de roca—Rock crystal.

Crucero—A cross cut.

Cruces—The cross pieces of the arrastres or grinding mills.

Cruzada—Applied to lodes, that which is crossed by another.

Cubo—A leather or other bucket.

Cuchara—The scraper used for extracting the pulverised ore or rock in the hole made to receive the charge for blasting; a spoon.

Cuchara de cuerno—A small horn bowl in which the earth of the tortas is washed, in order to ascertain from time to time the progress of the amalgamation.

Cuele—The art or effect of cutting or driving a mine; work in any direction; the distance or space advanced in a mining work.

Cuerda—A rope.

Cueros—Skins, generally of oxen, cows, &c.

Cuña—A wedge.

Curtir—The operation of adding lime to warm ores, or magistral to cold ores in amalgamation.

Cuerpo—The lode; also, body, as *cuerpo de la veta,* body, or main vein of the lode.

Cuerpo alto—Upper branch of the lode; upper story of a house or store.

Cuerpo baxo—Lower branch of ditto; ground floor of ditto.

Cuerpo medio—Middle branch of ditto.

These three terms are used where a lode is divided into three parallel branches with the same underlay, as at Veta Grande, Guanaxuato.

Dedo—The 12th part of a palmo; 4 palmos making 1 vara—12 dedos—8 pulgadas, or Spanish inches.

Demasia—Space unappropriated between mines, or otherwise.

Denuncio—*Denunciacion*—Denouncement; a formal application to the court of mines of the district, to have a mine adjudged to the applicant, the workings of which have been abandoned, or inefficiently carried on during the period fixed by the ordinance, or which has never been worked at all. A person has the power of denouncing a mine which has been unworked, or inefficiently worked, or depopulated for more than four months.

Deputacion de mineria—Mining tribunal.

Derecho—Straight, right.

Derrumbe or Derrumbamiento—The falling in of the works of a mine.

Desaguador—Water pipe or conduit.

Desagüe—Drainage.

Desagües—Outlets of every description by which the water is got rid of.

Descargue—Drawing off the last contents of the furnace, blowing out the furnace.

Descostradores—Men employed in taking down any fragment which may remain after blasting.

Descubridora (mina)—The mine in which the vein has been discovered, and which is entitled by law to a double *pertenencia* if in a district already worked, or a treble *pertenencia* if in a new district.

Desfrutar—To enjoy, to have the benefit of a mine.

Desmonte—Clearing away the surface of the ground; removing by the pick, blasting, or otherwise, the mountain rock, or breaking down ores.

Despacho—Plat; point of junction between a shaft and a level enlarged for receiving the ores, &c., to be sent up the shaft to the surface.

Despachadores—Men employed in filling the *mantas* with ores, &c.

Despensa—A store room for materials and tools, sometimes also for the quicksilver, and even for the bullion.

Despueble—Abandoning the mine, or omitting to keep the proper number of hands at work.

Destajo—Piece or contract work; tut work.

Destajero—Tut workman, or one who undertakes to work by contract.

Diamante—Diamond.

Dique—A dike.

Echadero—A plain where the mules are loaded, the metal spread out, cleaned, and weighed.

Echado—Inclination, or dip of the slope.

Ege—The axis of a wheel, axis of a carriage, &c.

Embolo—A piston.

Emborrascarse—Applied to a vein which has become barren at the spot then in work.

Emparejar—To level or square; to harness cattle, saddle them.

Empleo—The quantity of quicksilver mixed with the ore on any given occasion for effecting the amalgamation.

En bonanza—Yielding profitable returns.

Encampanar una mina—To cut off the workings of a mine on the underlay by working on the lowest works from the neighboring mine.

Encapillar—To form a chamber, or an enlargement of a working, preparatory to driving another work from it.

En frutos—In produce, producing ores.

Ensalmorar—The first process in amalgamation, the act of mixing the saltierra with the lama.

Ensayador—Assayer.

Ensaye—An assay.

Ensayo—A trial.

Escaleras—Ladders made of poles of timber, with notches cut in them or otherwise.

Esmanil—Blende.

Esmeralda—Emerald.

Esmeril—Emery.

Espato—Spar.

Espato Calizo—Calcareous spar.

Espato fluor—Fluor spar.

Espato pesado—Heavy spar; sulph. of lime.

Espejuelo—Mica.

Espeque—The cross level of the noria or tahona to which the mules are harnessed; a lever.

Estaca fixa—The post driven into the ground, from which the pertenencia is originally measured. *Estaca*, means a stake.

Estado—A statement or account.

Estaño—Tin.

Estanque—Pond, dam of water.

Estoraque—Brown blende, sulphuretted zinc.

Faenas—Work done by common laborers, such as dead work, removing rubbish, &c.

Faenero—Rubbish carrier.

Fanega—A dry measure, containing 12 celamines, or 1,599 of an English bushel.

Fanegada—An extent of land; 90 1-3rd fanegadas are equal to 100 English acres.

Feldespato—Feldspar.

Fierros—Stein, vulgarly regulus, from the smelting furnace.

Flete—Freight.

Fluorspato—Fluorspar.

Fluxo—Flux.

Fondon—A furnace for smelting ores.

Fosforo—Phosphorus.

Fosiles—Fossils.

Fragua—A forge.

Frios—In amalgamation, cold ores, those containing calcareous matter, and therefore requiring a larger quantity of sulphuric acid from the magistral.

Frente—An end; a forehead; an extremity of an adit or other level.

Frijolillo—A breccia.

Frixoles—French beans, the common food of the country.

Frutos—Produce, ore.

Fuelles—Bellows.

Fundidor—A founder, a smelter.

Fundicion—Smelting; also, the smelting-house.

Galena—Galena, sulphuret of lead.

Galera—A large shed, a mill-house, or grinding-mill; a large building on the floor of which the treading in of the quicksilver in amalgamation takes place.

Galleria—A gallery; a level.

Gallos—Small particles of silver, which appear in the shape of spherules on the surface of certain ores, after they have been strongly heated; more generally, however, applied to the spirting out of the silver from the assay button on cooling; also fine specimens of native silver, or other rich ores.
Gamela—A large wooden bowl.
Galpeador—A miner, who works with the mallet or hammer in blasting.
Granada—Garnet.
Granito—Granite.
Grano—A grain.
Granos de oro—Grains of gold.
Granza—Coarse particles of ore after grinding which require to be ground again; brayed ore.
Granzas—Poor ores.
Grasas—Slag from the smelting furnace.
Greda—Chalk.
Greña—Ores in the rough state, not cleaned.
Greta—Litharge, fullers' earth.
Gualdra—The large cross-beam in which the upper spindles of the shafts of machinery traverse.
Guarda—A rib of different substance from the rock or lode, which generally is upon the sides of the vein, called in Cornwall, cupels of a lode, or backs.
Guarda raya—Marks or limits of the boring, or measurement of the work done in a mine; limit or boundary line.
Guia—A mark directing to the richest part of the vein.
Guijarro—Pebble.
Guijo—The iron spindle of the shaft of machinery.
Guixa—Quartz.
Hallilitador—He who supplies money for working a mine.
Hachas—Axes, hatchets.
Hacienda—Farm; estate; establishment for reducing ores.
Hacienda de beneficio—Establishment for reducing ores.
Hacienda de fundicion—Establishment for smelting ores.
Haciendero—The superintendent of the hacienda.
Hechado—Dip of the lode.
Herramienta—Tools; taken figuratively, it implies a borer and hammerman.
Hierro—Iron.
Hierro colado—Cast iron.
Hierro labrado—Wrought iron.
Hilo—A small vein or thread of ore in a lode.
Hilo de la veta—Line or direction of the vein.
Hilos altos—Threads or small veins of ore falling into or proceeding from the upper or hanging wall of a lode.
Hilos baxos—Threads or small veins of ore proceeding from or falling into the lower wall of a lode.
Hoja de lata—Tin plate.
Hoja de laton—Sheet brass.
Hoja de libro—Finely laminated clay—slate; talc. *Lit.* leaf of a book.
Horno—A furnace.
Horno de fundicion—A smelting furnace.
Horno de magistral—Roasting stove for copper stove.
Huaco—A hollow.
Hueco—A hollow place.
Huembas—Small rough beams of buildings.
Hundido—Sunk in; workings which have fallen in.
Jantilla—A double-handed ladle into which the melted silver falls from the cras.
Jaspe—Jasper.
Jornaleros—Day laborers.
Jorongo—A small basket; also a blanket.
Incorporar—In amalgamation, to add the first charge of quicksilver. The term, *cebar*, is applied to the adding the subsequent charges; it also means the act of mixing in thoroughly the whole of the quicksilver, with the torta of wet ore.
Ingenios—Engines.
Instrumentos—Instruments, tools.
Intendente—Intendant.
Interventor—Inspector, representing the interests of the proprietors by whom appointed, or of the *aviador.*
Iridio—Iridium.

Labor—A work from which ores are extracted; in general, all work of the mine, and especially the front work.

Labores de hacienda—All workings in a mine not let to tributors.

Ladrillera—An iron or stone mould in which the melted silver is poured in order to form the barra.

Ladrillos—Bricks.

Lama—Slime or schlem from the amalgamation.

Lamero—The lama when merely thickened by admixture with saltierra.

Lameros—Lama pits.

Lancha—A sort of hard freestone.

Lapiz—Black lead.

Lapiz encarnado—Red chalk.

Laton—Brass.

Lava—Lava.

Lavador—A man employed in washing the ore after amalgamation, or rather, in cleansing the amalgam.

Lavaderos—Gold washings; washing vats or tubs for separating the amalgam from the lama or slime.

Lazadores—Men who procure people to work in the mine; also men employed to catch cattle.

Leña—Fire wood.

Leñadores—The workmen employed to carry and serve the wood in the smelting furnace; also, the wood cutter; collectors and sellers of fire-wood.

Lenter nillas—Large vertical wheels of the stamping apparatus.

Ley—Standard of the metals; contents in pure silver.

Ley de oro—Quantity of gold contained in the silver.

Ley de plata—Quantity of silver contained in the ore.

Libramiento—Warrant for payment for bars of gold or silver delivered at the mint, or order for funds.

Libranza—A bill of exchange.

Liga—Flux.

Limadura—An appearance put on by the quicksilver in certain stages of the process of amalgamation, which is noticed at the edges of the amalgam, washed in the bowl for making a *tentadura*, or trial.

Limpia—Clearing out of rubbish and ruins from the old work in a mine.

Lis—A particular state of the amalgam observed by means of the *tentaduras*, or trials, in the bowl.

Llano—A plain, flat ground.

Llevada—Carriage, transport.

Llevador—Carrier, conductor.

Lodo—Mud.

Losa—A flat stone.

Lumbrera—An air shaft; an adit shaft.

Macero—He who has the charge and direction of crushing and grinding the ore in the tahonas, previous to amalgamation.

Macizo—A solid untouched part of the vein.

Madera—Timber.

Maestro herrero—Master blacksmith.

Maestro carpintero—Master carpenter.

Magistral—Copper pyrites, used in amalgamation.

Malacate—A horse whim.

Malacatero—A whim driver.

Malacate doble, or Malacate sencillo—The former whim has bags made of two ox hides, holding 1,250 lbs. of water; the latter one hide, and holding half the quantity.

Maiz—Indian corn, the principal food used at the mines.

Manantial—A spring of water.

Mandadero—Errand boy.

Mandon—Master miner or overseer.

Manga—Level divided for ventilation; air pipes; a bag or strainer used to separate the quicksilver from the *pella*.

Manganesa—Manganese.

Manta—A blanket, or horse cloth, used to contain ores or tools to be brought up by the malacates, now replaced generally by sacks made of the fibres of the agave, or ox hides.

Mantear—To raise ores from the shaft in bags or mantas.

Manto—A bed or circumscribed stratum.

Maquina—A machine.

Maquila—Rate paid to the proprietor of a mill, or reduction work, for reducing ore on another party's account; applied chiefly to reduction by amalgamation.

Maquilero—One who dresses ores on hire.

Maquinas de vapor—Steam engines.

Marco—8 ounces or lb. Spanish, equal to 3,552 grains English.

Marco de oro—8 ounces of gold.

Marco de plata—8 ounces of silver. The marco de oro, or marco de plata may be standard, or otherwise.

Marmol—Marble.

Marcma—A rope to pull or draw by as a hawser.

Marquesitas—Mundic; iron pyrites.

Martillo—A hammer.

Martriquila—A registry for miners, &c.

Maza—Stamp head for pounding the ores.

Mecha—A match or fuze.

Medida—A measure.

Mejora—Improvement.

Mejora de boca—A term used when an improvement or alteration is made in the entrance to a mine.

Memoria—Weekly account of disbursements or mine expenses.

Mercurio—Quicksilver.

Merma—Loss of quicksilver in amalgamation, or of lead in smelting.

Meson—An inn mostly appropriated to muleteers, &c.

Metal—Metal; ore.

Metal de ayuda—Metal or ores added in smelting, to assist in the reduction of the silver ores; lead, or galena, for example.

Metal pepena—Selected and picked gold and silver ores.

Metales communes—Common ores.

Metales de fundicion—Ores for smelting.

Metales plomosos—Ores impregnated with lead.

Metales porosos—Porous ores.

Metapiles—Grindstones used in the tahonas; also pigs of copper used in the hot amalgamation.

Mexquite—Robinia, or acacia; a wood much used in mines.

Mineral—Ore; mineral; recently applied to a mining district, formerly and still called Real de Minas.

Mineria deputacion de—A tribunal cognizant of mining matters, elected in most cases by the mine-owners of the district.

Minero—A miner. an underground agent.

Minio—Red lead.

Modelos—Models.

Mojon—A land mark, used to mark the limits of pertenencias.

Molibdena—Molybdena.

Molienda—The act of grinding or pounding the ores, sometimes used to designate the ores ground "*La Molienda.*"

Molinete—Shaft of tina.

Molino or *Mortero*—Stamping mill.

Molonques—Crystalisation of silver ores; very rich.

Montaña—A mountain.

Montes—Woods.

Monton—A heap of ore; a batch under the process of amalgamation, varying in different mining districts. At Catorce, 36 quintals; at Guanaxuato. 35 quintals; at Real del Monte, Pachuca, Sultepec, and Tasco, 30 quintals; Zacatecas and Sombrerete, 20; Fresnillo, 18; Bolanos, 15; and at Valenciana, 32.

Mozo—A man servant.

Muestras—Samples.

Mufla—A tuyere.

Natas o Escorias—Slags.

Natron—Native carbonate of soda.

Negociacion—Business; undertaking as a mine, or set of mines, &c.

Nicolo—Nickel.

Nitro—Nitre.

Nivel—Level.

Niveles de agua—Water levels.

Noria—An endless chain with buckets attached, revolving round a wheel; it is used under-ground for drawing water out of the pozos or sinks, which are carried down to a greater depth than the principal shaft; also, a common superficial machine for raising water.

Obras—Workings.

Ocre—Ochre.

Ocre rojo or *Ocre colorado*—Red ochre.

Official de albañil—Journeyman bricklayer.

Official de carpintero—Journeyman carpenter.

Ojo—Bunch or small spot of ore in a lode.

Ojo de polvilla—Spots of rich ore.

Ojo de vibora—Black sulphuret of zinc.

Onique—Onyx.

Opalo—Opal.

Operanos—Workmen.

Ordenanzas de mineria—Code of mining laws.

Oro—Gold.

Oro de copela—Fine gold.

Oro empolvado—Gold dust.

Orphimento or *Oripomente*—Orpiment.

Pacos—Earthy ores, consisting of oxide of iron mixed with various ores of silver; when of a red color they are frequently called colorados; they are generally found near the surface.

Paja—Straw.

Pala—A wooden shovel.

Paldion—Palladium.

Palanca—A lever, a pole on which a weight is supported by two men.

Palansa de hierro—Crowbar.

Palmo—Quarter of a vara or Spanish yard.

Panino—The ground or country through which the lode runs; also, the matrix.

Panizo—Hornstone.

Parada—A relief or change of men, mules, or horses.

Parcionero—A partner in the mines.

Parihuela—A letter.

Partido—Division of ores between the owners and buscones.

Pasta—Uncoined silver.

Patio—A yard; court; floor of a court on which the ores pass through the process of amalgamation.

Patio de amalgamacion—Amalgamation court.

Pegador—Man who sets fire to the matches for blasting.

Pella—The silver mixed with quicksilver when all the latter metal has been forcibly pressed out, except the portion which can only be separated by distillation.

Peltre—Pewter.

Peones—Native laborers or assistants; day laborers.

Pepena—Picked ore of the best quality; rich ore.

Pepenado—Cleaned ores.

Pepenadores—Cobbers, cleaners, and classers of the ores.

Pepitas—Small grains of native silver or gold.

Peritos—Intelligent or practical persons selected as arbitrators to decide scientific or practical questions or disputes, or to determine the underlay of veins prior to fixing the limits of the *pertenencias*.

Perta margarita—Pearl.

Pertenencia—Extent of 200 varas upon the course of a lode to which a title is acquired by denunciation; the breadth varies according to the underlay of the vein from $112\frac{1}{2}$ varas to 200 varas.

Peso—A dollar; any weight.

Petlanques—Crystalisations of siver ores; also, silver ores which are very conspicuous in the matrix; for example, petlanque colorado is the red antimonial silver, whether crystalised or otherwise.

Pez—Pitch.

Pico—A miner's pick.

Piedra—Stone.

Piedra de toque—Touchstone.

Piedra cornea—Hornstone.

Piedra iman—Loadstone.

Piedra podrida—Rotten stone.

Piedra pomez—Pumice stone.

Piedras de mano—Good pieces of ore, sometimes carried up by hand, and often assigned to pious purposes.

Piedras preciosas—Precious stones.

Pilares or *Pilarejas*—The pillars of a mine.

Pileta—A trough; the hollow basin before the smelting furnace into which the metal flows; tank or small reservoir underground to collect the water of infiltration.

Piña—The cake of silver left after the quicksilver has been distilled off.

Pinta—The appearance, whether favorable or unfavorable, of a fragment detached from the lode; the mark of particular metals by which their value is recognised according to their appearance to the eye.

Pintra—To exhibit pintas, or indications of ores.

Pirites—Sulphuret of iron.

Piso—The bottom or floor of a work.

Pison—A rammer.

Pita—Thread made of the fibre of the agave or maguey.

Pizarra—Slate.

Plan—A bottom working, or working driven from the bottom of a level, adit, &c.

Plancha—Pigs, as *plancha de plomo*, pigs of lead.

Plata—Silver.

Plata de ley—Standard silver.

Plata parda azule y verde—Muriate of silver of different colors.

Plata piña—Silver after distilling off the mercury.

Platina—Platinum.

Pleito—A law suit.

Plomo—Lead.

Plomosos—Applied to ores containing lead.

Poblar—To set on workmen in any mine.

Polvillones—Rich ores.

Polvillos—Applied to ores, tender, rich.

Polvillos buenos—Good ores of the kind.

Polvo—Dust.

Polvora—Gunpowder.

Polvorilla—Black silver, disseminated sulphuret of silver.

Porfido—Porphyry.

Potaza—Potash.

Pozo—A sink on the inclination of the vein; a pit, a well.

Presa—A dam.

Protocolo—Minutes.

Pueble—Actual labor in the mine with the number of workmen at least prescribed by the mining laws.

Puertas—Very strong rock which conceals the vein, and which requires blasting ere the vein is discovered; also doors.

Pulgada—An inch.

Quadrado—A square.

Quajado—Dull lead ore.

Quarzo—Quartz.

Quebrada—A ravine.

Quebradores—Cobbers or breakers of the ores; men who break up the ores on the surface.

Quemadero—Burning house or place.

Quemazon—The barren scorched appearance of the crest of a metalliferous lode protruding from the surface of the mountain.

Quilate—Synonymous with carat; for example, gold of 22 quilates contains 22-24th parts of pure gold, just as the English standard gold of 22-24th parts of pure gold. The quilate is divided into 4 granos Spanish.

Quintal—4 arrobas or 100 lbs. Spanish, equal to 101 45-100 lbs. English.

Quita pepena—A man who stands at the mouth of the shaft to see that none of the metal is stolen.

Ramo—A branch from the main vein.

Rancho—A detached farm-house and ground; the house is often nothing more than a hut.

Raya—Weekly account of the mine expenses.

Rayador—Clerk who keeps account of the workmen's time, the stores received, &c., &c.

Real—1-8th of a dollar; a mining district,

Real de minas—The term generally applied to a mining district; although Mineral de Minas is also now used.

Reata—A rope about as thick as a finger, or larger, used as lashings to *cargas.*

Reatilla—A single twisted smaller rope.
Rebaxe—A working down of high ground.
Reboltura—A mixture of the ground ore with the usual re-agents or fluxes.
Rebosadero—Crest of a vein.
Recina—Rosin.
Recuesto—Inclination of a vein.
Regador—One who has a right to a certain share of water for irrigation.
Registrar—To get an entry made by the proper officer of a party taking possession of a new mine.
Registro—An entry as above described.
Reliz—The wall of the vein.
Remolino—Mass or bunch of ore.
Rendirse—In amalgamation, said of a torta when the amalgamation is complete.
Repasador—Laborer who treads the quicksilver into the ores under amalgamation.
Repasar—The mixing together of the ore, quicksilver, and other ingredients in the wet state, in order to extract the metal; to work the quicksilver into the tortas of ore under amalgation, done by treading them with mules or men.
Rescatador—Ore purchaser.
Rescate—Public sale of ores.
Retortas—Retorts.
Rio—A river.
Riscos—Crystals.
Rosicler—Ruby silver; red antimonial ore.
Rubi—Ruby.
Ruedas—Wheels.
Rumbo—Point of the magnetic compass.
Rumbo de la veta—Line or direction of the vein.
Saca—The ore obtained from a mine in a given space of time.
Sacabocados—Punches.
Sacabuches—Hand pumps.
Sal—Salt.
Sala—The principal room of a hacienda, or any other building.
Salitre—Saltpetre.
Sal mineral—Mineral salt for amalgamation.
Sal tierra—Impure or earthy salt.
Salineros—Applied to ores requiring much salt in amalgamation,
Salones—Saloons, large halls, hollows, or cavities in a lode.
Sangria—Letting off water by piercing the rock or other substance which dammed it in.
Sanguinaria—Blood stone.
Scrape—Blanket, the usual dress of miners.
Sebo—Tallow or suet used for machinery, &c.
Sierras—Saws; chain of mountains.
Silla—A saddle; a leather which passes over the men's shoulders to protect them in carrying the ore.
Sitio de labor—Land measure, 5,000 varas in diameter.
Sobrante—Surplus, profit, residue.
Socabon—An adit or water level driven from the earth's surface, either on the course of a lode, or to intersect it.
Soga—The rope to which the bota is attached.
Soguilla—The rope for the botillas de burro, botas chicas, or mantas.
Soldadura—Solder.
Soliman—Corrosive sublimate.
Sombra—Shade; grey tinge of certain ores or matrices of ores.
Soto minero—Sub-miner.
Soplete—A blow-pipe.
Sucino—Amber.
Tablas—Planks.
Tahona—A mill of small horizontal stones.
Tajadera—Wedge to break the tinas.
Tajo—A cut.
Tajo abierto—An open cut.
Talco—Talc.
Talega—Bags of dollars, containing 1,000.
Tanda—Task; compulsory labor; days appointed for working the mine; duration of the period in which a regador is entitled to use running water for irrigation.
Tanque—Tank or artificial pond.

Tantalio—Tantalum.
Tapa ojos—Bandage for the eyes; used to cover the eyes of mules when treading the ore in the patio, or elsewhere.
Tarea—A task; also a certain quantity of wood for fuel; the quantity cut upon one task.
Tejamanil—Shingle for roofing.
Tejo—Cake of metal.
Tellurio—Tellurium.
Tenatero—Ore carrier from the workings to the surface, or to the despacho only.
Tenates—Sacks made of pita, or hide, for raising the ore on men's shoulders; large leather or coarse linen bags, in which the tenateros remove the ores and rubbish.
Tentadura—An assay or trial.
Tepetate—Rubbish remaining after cleaning the ores; also applied to all the earth of the mine which contains no metal; barren rock through which the ore runs.
Terquesite—Native carbonate of soda.
Terreros—Heaps of attle and rubbish from the mine.
Tersoreria—Treasury.
Testera—A dyke interrupting the course of a lode.
Texear bien en horno—When the litharge is thrown out from the furnace.
Tienda de raya—A shop at which the miners obtain weekly credit.
Tierra pesada—Barytes.
Tierras—Earths, applied to ores, earthy, poor.
Tierras apolvillados—Ores a degree inferior to azogues apolvillados.
Tierras communes—Common earthy ores.
Tierras de morlero—Poor stamped ores.
Tina—A vat or jar.
Tiro—A shaft.
Tiro de mulas—A set of mules.
Tiro general—The principal shaft.
Titanio—Titanium.
Tornero—A wooden vat.
Torta—A certain quantity of ore under amalgamation forming one heap, which being of a flat shape is called a torta or cake.
Torta rendida—Amalgam ready to undergo the washing operation.
Trementina—Turpentine.
Triangulos—The cogs of the stamps.
Tribunal de mineria—Mining tribunal.
Trompeto—A small malacate.
Tungstena—Tungsten.
Turba—Turf, peat.
Turbit mineral—Yellow oxide, or sulphuret of mercury.
Uranio—Uranium.
Vapor—Steam; foul air in a mine.
Vara—A Spanish yard, equal to 33 inches English nearly; 109 30-100th varas, equal to 100 English yards.
Velador—A watchman who takes care of the mine day and night; an under miner.
Velas—Candles.
Vena or Veta—A vein or lode; it is called *manta* (a cloak) when it is a bed; *clavada* (upright) when it is vertical or nearly so; *echada* (inclined) when it has a certain dip or inclination; *obliqua* (oblique) when it goes in that direction through the mountain; *serpenteada*, when in a serpentine direction; *socia* (companion) when it is joined with another; *rama* (branch) when it proceeds from the main vein.
Verde tierra—Verditer.
Vermellon—Vermilion.
Veta madre—The mother or principal vein.
Vidrio—Glass.
Vigas—Beams, split or sawed timber.
Vitriolo—Vitriol.
Vitriolo azul—Blue vitriol.
Vitriolo blanco—White vitriol.
Vitriolo verde—Green vitriol or copperas.
Voladoras—Grinding stones of the arrastres.
Vuelta—The glow of the silver in cupellation when the last film of oxide of lead suddenly separates and disappears.
Xabon—Soap; a peculiar description of ores.

Xabones buenos—Good ores of the above description.
Xacal—A hut in which ores and tools are kept.
Yesca—Vinder or touchwood.
Yeso—Sulphuret of lime.
Yunque—Anvil.
Zacate—Maize straw or grass given to the mules.
Zanca—A ditch.
Zurron—A sack made of leather; Cochineal is packed in zurrones.

FRENCH, SPANISH, AND GERMAN SMELTING TERMS.

CONTRACTIONS.—Fr. *French;* Sp. *Spanish;* Gm. *German.*
Cp. Copper; *Sl.* Silver; *Ld.* Lead; *Tn.* Tin; *Ir.* Iron.

Abstrich—Gm. sl.; impure brown litharge, in silver refining.
Abzug—Gm. sl.; sulphurated litharge dross, in silver refining.
Affinerie—Fr.; refining metals.
Arastre—Sp. sl.; crushing mill.
Aspirateur (fourneau)—Fr.; air or wind furnace.
Autel—Fr.; the fire bridge of the air furnace.
Battitures—Fr.; forge scales of oxide of iron.
Bleistein—Gm. ld.; regule from coppery (&c.) lead ores.
Blicksilber—Gm. sl.; crude silver, from silvery lead, not quite fine.
Brandsilber—Gm. sl.; refined silver, from silvery lead.
Brasque—Fr.; lining of close beaten charcoal.
Cadmies—Fr.; metallic soot; sublimate.
Capelline—Sp. sl.; the iron bell under which the silver amalgam is distilled downward.—See Pina.
Carcasses—Fr. sl.; coppery residues of liquiation for silver.
Castine—Fr. ir.; limestone.
Centner—Gm.; proportionate weight of 100; whether pounds, ounces, loths, or grains.—See Loth.
Chemise—Fr.; lining of a furnace.
Cingler, Cinglage—Fr. ir.; shingling.
Crasses—Fr.; clots, dross.
Creuset—Fr.; crucible; receiving pit of a furnace.
Cuivre Ampoulé—Fr. cp.; crude copper ready for refining called "pimple copper."
Cuivre en Grains—Fr. cp.; beanshot copper.
Cuivre en Plumes—Fr. cp.; feathershot copper.
Cuivre Noir—Fr. cp.; coarse copper for refining.
Dame—Fr. ir.; the front hearth stopper of the high blast furnace.
Darrlinge—Gm. sl.; copper residue from silvery copper, sweated out by lead.
Decrassage—Fr.; skimming, cleaning.
Dunnstein—Gm. cp.; poor copper regule.
Eclair—Fr.; the "brightening" of fine silver in cupellation.
Erzmehle—Gm.; ground ore.
Etain en larmes—Fr.; grain tin.
Fallung—Gm.; precipitation in watery solution.
Floss-ofen—Gm. ir.; the high blast furnace.
Fonte—Fr.; cast metal; generally cast iron.
Fonte crue—Fr.; fusion of regule from raw ore.
Fourneau a manche—Fr.; low blast furnace.
Foyer—Fr.; fire-hearth of a furnace; focus.
Fraisil—Fr.; broken small charcoal.
Frischstuck—Gm. sl.; silvery lead eliquiated from silvery copper ore.
Gahreisen—Gm.; the iron rod for drawing the sample.
Gahrkupfer—Gm.; refined copper.
Gahrost—Gm.; the copper after the last roasting.
Gahrproof—Gm.; refining test.
Gahrschlag—Gm.; refinery slag.
Gahrspan—Gm.; the refining assay sample.
Gift mehl—Gm.; arsenic soot.
Heller—Gm.; a weight, $\frac{1}{2}$ pfennige; about 7 grs. impl.—See Pfennige.
Houille Grasse—Fr.; bituminous coal.
Houille Seche—Fr.; coal little or not bituminous.
Hutte—Gm.; foundery; kiln; smelting furnace.
Huttenwerke—Gm.; smelting-house.
Kornig—Gm.; grainy, as *grob-kornig*, coarse-grained.

Krummofen—Gm.; low blast furnace.
Kupferleg—Gm.; regule from bleistein, roasted with quartzy copper ores, &c.—See Bleistein.
Kupferstein—Gm.; regule from coppery lead ores, twice roasted.
Laitiers—Fr.; fusible slags.
Lama—Sp. sl.; fine ground ore, ore mud.
Lingotiere—Fr.; ingot mould.
Loth—Gm.; a standard weight about ½ ounce impl.
Loupe—Fr. ir.; the ball or bloom from the puddling furnace.
Magistral—Sp. sl.; roasted copper ore, for mixing in the amalgam heap.
Matte—Fr.; regule, melted sulphuret.
Mineral—Fr.; ore.
Monteros—Sp. sl.; stampers.
Monton—Sp. sl.; small heaps of ore mud, for amalgamation.
Niederschlag—Gm.; precipitate.
Noyer—Fr. sl.; the assay being covered with unabsorbed litharge.
Offenbruch—Gm.; metallic soot or sublimate.
Paillasse—Fr.; the bed of a furnace.
Patio—Sp. sl.; amalgamation floor.
Pfennige—Gm.; a weight, 1-16th loth.—See Loth.
Pina—Sp. sl.; piles of amalgam for distilling down the mercury.
Plata Pina—Sp. sl.; the porous silver cakes left after distilling down the mercury.
Plomb d' Œuvre—Fr. sl.; silvery lead for refining.
Pocherz—Gm.; poor ore.
Poussee—Fr. sl.; fusion with nitre, to scorify the copper, &c., and leave the silver.
Quintal Metrique—Fr.; 100 kilogrammes, nearly 217 imperial pounds.
Quintlein—Gm.; a weigh ¼ loth, or 1-16th ounce.—See Loth.
Rable—Fr.; rabble; a toothless iron rake, for skimming, &c.
Raffinage—Fr.; refining.
Rafraichissage—Fr. sl.; melting the silvery copper, &c., with lead, to extract the silver.
Refractaire—Fr.; fireproof.
Ressuage—Fr. sl.; sweating out the lead for eliquiating the silver from silvery copper, &c.
Reverbere—Fr.; reverberatory (furnace.)
Ringard—Fr.; iron rake for stirring melted metal.
Rocher—Fr. sl.; the "branching" thrown out by fine silver in cooling.
Rohstein—Gm.; copper regule, first fusion.
Rondelle—Fr.; the round cake of rosette copper.
Rosette—Fr. cp.; refined copper, coated with bright red oxide, by plunging hot into water.
Rosten—Gm.; roasting.
Rost-stadeln—Gm.; enclosed roasting, sometimes called "case roasting."
Rotissage—Fr.; roasting.
Rustine—Fr. ir.; backstone of the high furnace hearth.
Saigerdorn—Gm. sl.; the coppery residue from darrlinge, (which see,) after sweating out most of the lead.
Saigergasse—Gm. sl.; eliquiation gutter, to draw off the eliquiating lead from silvery copper, &c.
Saltierra—Sp. sl.; salt earth (containing 12 or 13 per cent. salt) for mixing in the amalgamation heap.—See Torta.
Saumons—Fr.; blocks of metal, especially tin.
Schachtofen—Gm. ir.; high blast furnace.
Schlacke—Gm.; slag, scoria.
Schlackstein—Gm. cp.; very poor regule, chiefly iron and sulphur.
Schlamm—Gm.; fine ground ore.
Schlich—Gm.; fine ground ore; ore mud.
Scories—Fr.; metallic slags.
Seigerung—Gm.; eliquiation.
Spadele—Fr.; shovel for turning the roasted ore.
Speise—Gm.; metallic sediment from cobalt glass, contains nickel.
Speissig—Gm.; fibrous, as *klar speissig*, fine fibrous.
Spleiss-ofen—Gm. cp.; split furnace; refining furnace with two receivers.
Spurrost—Gm. cp.; regule after three roastings.
Spurrstein—Gm.; the spurrost melted.
Stahlstein—Gm.; crude steel from the ore.
Stofferz—Gm.; pure ore.

Stuckofen—Gm.; half-high blast furnace.
Tellersilber—Gm. sl.; silver left from distillation of the amalgam.
Titre—Fr.; the proportion of precious metal in an alloy.
Tole—Fr.; sheet iron.
Torta—Sp. sl.; the great flat heap of silver ore, for amalgamation.
Trapiche—Sp. sl.; grinding mill.
Treibheerd—Gm. sl.; refining furnace.
Treibscherben—Gm. sl.; large compact cupells; roasting tests.
Triage—Fr.; sorting, picking.
Trockene Schneidung—Gm.; separation by fire.
Trompe—Fr.; water blowing engine.
Tuyere—Fr.; tube, blast-pipe.
Usine—Fr.; smelting house.
Verquicken—Gm.; amalgamation.
Verschlacken—Gm.; scorification.
Wismuth Graupen—Granular bismuth, eliquiated from the ore.

JOURNAL

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FOR THE

PROMOTION OF THE MECHANIC ARTS.

MAY, 1848.

CIVIL ENGINEERING.

Annual Report of the Board of Canal Commisioners, for the fiscal year ending November 30, 1837.

(Continued from page 226.)

The Board respectfully refer to the accompanying report of the superintendent of motive power, for a more detailed statement of the operations of the road.

The main line of canal was opened for navigation, on the 11th of March, and continued in operation, with but few slight interruptions, until the occurrence of the flood of the 7th of October.

The Eastern division sustained very little injury from the floods.—Conewago and Stony Creek aqueducts received new superstructures, and were widened. The other necessary repairs mentioned in the last estimates, were all made during the year. The re-building of Clark's Ferry bridge has been completed, at a cost of thirty-six thousand and ninety-eight dollars and fifty seven cents, being eight hundred and seventy-four dollars and eighty-two cents less than the estimate.

The Juniata division suffered more severely from the flood than any other portion of the lines of canal. The river rose thirty-three feet at some points, inundating the canal, washing away the banks, and destroying or materially injuring many of the mechanical structures.—Several heavy breaches occurred between the Junction and Millerstown dam. The dam and guard lock were injured, and the sheeves of the rope ferry carried away. From this point to Lewistown the greatest damage received was the destruction of the Thompsontown aqueduct, and the washing away of the towing path, and the filling up of the bottom of the canal, between Mexico and the head of the Long Narrows. From Lewistown to Aughwick dam, the damage was confined to a few breaches in the banks. From Aughwick dam to the head of the line at Hollidaysburg, the greatest injury was sustained. The dams, with one or two exceptions, were more or less damaged; several locks were swept off, and others injured; the aqueducts were either carried away, or so much shattered as to require rebuilding or extensive repairs; and the banks of the canal for miles washed away, and the bottom filled up with the deposit left by the receding waters.

The navigation of the upper portion of the division was, as a matter of necessity, closed for the remainder of the season. But as it was practicable to place the lower part of the line in order before the close of navigation, and as it was known that a large amount of tonnage was detained by the breaches from reaching its destination, or waiting their repair to reach a market, it was considered a matter of convenience to the business community, and of public economy, to commence the repairs without delay. A large force was consequently placed on the division between the Junction and Newton Hamilton. The work was prosecuted with vigor, and the repairs so far completed, as to permit the resumption of navigation between these points on the 18th of November, after a suspension of forty days. On the 24th of November the line was visited by another flood, which caused a few breaches, and some injury to the structures under repair, and detained the navigation for three days. This was succeeded by a third flood, on the 12th day of the present month, which did considerable damage to the line, and caused the entire suspension of navigation.

The total estimated cost of the damage to the whole division by these floods is two hundred and twenty-two thousand five hundred and thirty-five dollars and sixty-one cents.

All the necessary arrangements have been made by the officers on this division to complete the repairs by the middle of February, so as to insure the opening of the entire main line at the earliest period at which the weather will permit in the spring. There can be no doubt of the accomplishment of an object so essential to advance the public interests, if the Legislature make a partial appropriation for repairs at any early day of its session, in advance of the general appropriation bill. The work can be done in time, if the funds be provided at the proper season.

A large item of repair expense might be annually saved by substituting slackwater for the present navigation through the Long Narrows, below Lewistown. A dam at the head of these narrows feeds the level which passes through the contracted gorge of the mountain. In times of flood, the waters become compressed at this point, overflow the canal banks, and almost invariably do great damage to the protection wall, the towing path, and the bed of the canal.

This drain upon the repair fund, and the frequent detention at this point, could be obviated by the construction of a dam at the lower end of the narrows, thus forming a slackwater backing up to the dam above. This improvement could be completed at a cost not exceeding the expense incurred within a few years past for the repairs of the piece of canal which would be thus abandoned. It would be economical, and afford a better line of transportation. The propriety of making the change is worthy the consideration of the Legislature. Should that body at its coming or any succeeding session, concur in the suggestions of the Board, an estimate of the cost will be laid before it.

Upon the Western division, the navigation has experienced but little interruption during the season. The lower portion of the line escaped damage by the flood of October. On the upper portion, dam No. 5, and the dam at the head of the basin at Johnstown, received considerable damage, and several breaches occurred in the banks of the canal. · The repairs were, however, so far advanced as to permit of the resumption of navigation after a suspension of one week. The principal extraordinary repairs which will be required on this line during the present winter, are, the replacing of the superstructure of the Pine Creek aqueduct; repairs to the aqueduct over the Allegheny, near Freeport; the repairing of water ways, slope wall, &c.

The net revenue from the main line of canal, was two hundred and forty-five thousand nine hundred and thirty-three dollars and forty-eight cents. Total net revenue on whole main line of canal and railroad, six hundred and twenty thousand seven hundred and fifty dollars and sixteen cents.

The navigation on the Susquehanna division was opened on the 12th of March. This line did not escape the effects of the flood of October. A heavy breach occurred at the Junction, at the head of Duncan's island; and another at the upper end of the culvert over Wild Cat creek, below Liverpool. The requisite repairs were made as soon as practicable, and the navigation re-opened after a suspension of about three weeks. As the spans of the culvert over Wild Cat creek are too contracted to discharge the waters in extraordinary freshets, and as the structure requires extensive repairs, if not re-building, it has been determined to substitute an aqueduct for the culvert. This will be done during the present winter, at an expense not much exceeding the repair of the culvert, and at the same time effecting a desirable improvement in the line. The aqueduct over Penn's creek, the locks, water-ways, &c., will require some repairs. Cost of damage by floods, six thousand nine hundred and four dollar.

The winter repairs upon the West Branch division were completed, and the navigation opened, on the 18th of March, and remained uninterrupted until the 25th of September, when a rise in Delaware run caused the waters to break into the canal, making three large breaches in the level. This was succeeded by the flood of the 7th and 8th of October, which made numerous breaches in the canal, washed away the banks in various places, partially displacing and damaging the aqueducts over Larry's and Lycoming creeks. The dam at

Queen's run was injured, and the water broke in around the Muncy dam, on the west side, and washed the bank away for about three hundred feet, and taking out some two acres of land. The structures were temporarily repaired, and the banks of the canal placed in a condition to pass boats; but on the 12th of this month another flood occurred, which made several breaches on the line, and closed the navigation for the season. Estimated cost of repairing the damage by both floods, nineteen thousand dollars. To place this line in order for the spring business, it is requisite that an early appropriation should be made by the Legislature.

The repairs to the mechanical work, and the banks and bed of the North Branch division, delayed the opening of navigation until the 10th of April. As the line received no injury from the floods, the transportation upon it was uninterrupted until the close of the season, with the exception of seven days, caused by the giving way of a culvert and the high water in the river. The repairs to Nanticoke dam are not quite completed. About ninety feet of cribbing and filling are required to make it secure. The shute of the dam is in bad condition, and will require considerable repair.

Total estimated cost of repairing damage by floods on all the lines, two hundred and sixty-five thousand nine hundred and thirty-nine dollars and sixty-one cents.

In pursuance of the act of the 16th of March, 1847, authorizing the construction of a weigh-lock on the North Branch division, the Board, after an examination of several sites, located the lock at Beach Haven, on the lower end of the first level below Nanticoke dam. This location, in addition to its other advantages, avoids the necessity of wasting water when weighing boats, as the water from the lock will be discharged through a culvert into the level below. Proposals were issued for the construction of the lock, and the work allotted to Pettibone and Marcy, who are progressing with the work, and will have it completed by the opening of navigation. It will be a composite lock, ninety-two feet long in the chamber, and seventeen feet wide in the clear. A contract was also entered into with Messrs. Ellicott and Abbott of Philadelphia, for scales of an improved construction. They have been partly delivered, and will be put up as soon as the lock is completed.

The toll received on the Susquehanna and North and West Branch divisions, in 1847, was one hundred and eighty-five thousand eight hundred and thirty-nine dollars and seventy-four cents, being an excess of thirty-three thousand seven hundred and four dollars and fifty-two cents over 1846.

The Delaware division has been in successful operation from the opening of navigation, on the 13th of March, to the close of the season, having experienced but a few slight interruptions throughout the year. The repairs for the year were of the usual ordinary character, and were executed in an economical manner. A reference to the table of receipts and expenditures will show that there has been a gratifying increase of business on this valuable portion of the public improvements over the last year. The excess of receipts over expenditures in 1847, amount to one hundred and forty-eight thousand eighty-two dollars and sixty-seven cents, making a large interest on one million three hundred and eighty-four thousand one hundred and thirty-six dollars and ninety-six cents, the original cost of construction.

Under the provisions of the act of the 20th of April, 1846, entitled "An act authorizing the construction of an out-let lock on the Delaware division, Pennsylvania canal," the Board, on the 26th of April last, advertised for proposals for a loan of twenty thousand dollars, for the construction of the lock at Wells' falls, to be re-imbursed in the manner prescribed by the act. The loan was taken by C. Macalister, at an interest of five per cent., and deposited in the State Treasury on the 11th of June last. A certificate was issued to Mr. Macalister, by the Board of Canal Commissioners, in accordance with the provisions of the act of the Legislature. Proposals were immediately issued for the construction of the work, which was allotted to the lowest bidders, Sumner and Delano, at the gross sum of eighteen thousand dollars. The work was commenced forthwith, and is now nearly completed, and only awaits the discharge of water from the canal, in order to sever the intermediate portion, and form the proper connexion with the canal prism. This improvement consists of a guard-lock one hundred and twenty-two feet in the chamber, a canal nine hundred feet in length, and an out-let lock two and a-half feet lift, with chamber one-hundred and twenty-two feet in the clear. The locks are built of ruble masonry, laid in the best hydraulic cement. The towing path is paved one foot thick on top, thoroughly walled both outside and in, and altogether is believed to form a complete and durable work. A connexion will thus be formed with the Delaware and Raritan canal, without any diminution of the revenues of the line, the act prescribing that boats passing in or out at the lock, shall pay tolls for the whole distance between Easton and Bristol.

The Eastern reservoir, designed to supply the upper levels of the Juniata division, during the dry season, has been completed, and was put in operation during the season just closed. It is believed it will fully answer all the purposes of its construction. The actual cost of its construction was $32,566·17; amount appropriated, thirty thousand dollars, leaving a balance of $2,566·17 to be provided for.

In their last annual report the Board stated that "the large expenditures required for repairing the damage, by the last spring's flood, to our public works, induced the Board to defer placing the work at the Western reservoir under contract at the time they had intended, and no measures other than receiving proposals for it, have been taken for its prosecution." The utility of such a feeder to the Western division has been practically demonstrated during the short period the reservoir on the eastern side of the mountain has been in operation. But as it is doubtful whether the appropriation made to complete this work, by the act of the 31st of January, 1846, has, or has not, reverted to the general funds of the Treasury, it remains for the Legislature to determine whether it shall be completed and brought into use.

Petitions from all sections of the Commonwealth, numerously and respectably signed, have, at different times, been presented to the Board, praying that the public works may be closed on the Sabbath day. After having given to these petitions that consideration which was due to the character and the object of the memorialists, the Board came to the conclusion that they had no jurisdiction over the matter. They therefore, respectfully refer the subject to the Legislature.

All the claims for damages under general or special acts, in which sufficient testimony has been produced, have been acted on; and the awards, where damages have been allowed, will be found in statement No. 3, excepting in those cases requiring special reports, which will be made at an early day of the session. The general appropriation bill of the last session enacts that "no awards made under general or special laws previous to the 1st of January, 1847, shall be paid until a special appropriation shall be made therefor." Several demands have been made for the payment of awards reported to the Legislature previous to the last session, which could not be complied with, owing to the restrictions of this act. It would seem to be due to these claimants that some general provision should be made for their relief.

The act of the 16th of March, 1847, to provide for the ordinary expenses of government, &c., appropriated the sum of ten thousand dollars for re-building public and farm bridges over the canals and railroads. Of this amount, four thousand two hundred and twenty-five dollars have been drawn from the Treasury, leaving a balance of five thousand seven hundred and seventy-five dollars, which will be applied to the repair of bridges during the present season.

The estimated cost for repairs in 1848, is exhibited in the accompanying statement, No. 2. The amount therein asked for, of two hundred and thirty-three thousand three hundred and sixty dollars, for ordinary and extraordinary repairs, and two hundred and four thousand five hundred dollars for the repair of breaches by the late floods, will be amply sufficient for the purpose, should no similar disaster occur, provided the usual appropriation is made of fifty thousand dollars, for the purchase and preparation of materials for executing repairs after the 1st of December next.

The act of the 20th of April, 1846, appropriated fifty thousand dollars for the purchase and preparation of materials for repairs after the 1st of December, of that year. Of this sum, twenty-three thousand six hundred and ninety-four dollars and forty-seven cents were expended for those purposes previous to the 1st of December, 1846. In their last annual report, the Board remarked that "in the appropriation of April 20, 1846, the usual contingent fund for breaches, &c., was omitted; and a large amount of extraordinary repairs of this character have been made during the past season, rendered necessary by frequent floods, land slides, breaches, and other casualties. These causes have operated to exhaust the existing appropriations for repairs of the canal and railroads, and unless funds are immediately provided, the current repairs during the winter, cannot be as promptly and economically made as they ought to be. In consequence of the expense of these extraordinary repairs in 1846, the balance of the before mentioned appropriation of fifty thousand dollars, amounting to twenty-six thousand five hundred and five dollars and fifty-three cents, was absorbed in the payment of debts due for repairs previous to the 1st of December, 1846, with the exception of six hundred and fifteen dollars and seventy-one cents, which was applied to the repairs of 1847. As the Legislature omitted to make an appropriation for breaches, at its last session, the Board were compelled to expend thirty-five thousand three hundred and forty-four dollars, of the fifty thousand dollars appropriated for materials and repairs after the 1st of December, 1847, in the repair of the damages by the several floods. This has necessarily left the different lines of canal and railroad in debt for ordinary repairs. No appropriation for the payment of these debts will be required if the amounts asked for in the estimates be granted.

As the funds appropriated by the Legislature were nearly exhausted soon after commencing the repair of the breaches by the flood of October, the Board found themselves under the necessity either of abandoning all further operations, which would have put it out of their power to place the canals in order for an early spring business, or of obtaining the means of prosecuting the repairs in advance of the meeting of the Legislature. To have suspended the repairs at that time would have been productive of certain loss to the revenues of the Commonwealth. In this emergency, the Board deemed it their duty to hold a conference with the Governor and State Treasurer, as to the proper course to be pursued. The result of that conference was a circular addressed by the Governor to several of the banks holding on deposit the State funds, asking them to place, on their own responsibility, the sum of fifty thousand dollars, in the aggregate, to the credit of the Treasurer of the Board of Canal Commissioners, to be applied exclusively to the repair of damages by the floods—trusting to the Legislature to replace the amount to their credit at an early day. The banks complied with the request, and the money, so far as drawn out, has been solely applied to the object contemplated. This sum of fifty thousand dollars is included in the estimates of the present year for the repair of breaches.

The Board would earnestly recommend to the Legislature the propriety of adopting some provision, under proper restrictions, for the repair of extraordinary breaches, when the specific appropriations have become exhausted. The disasters of the present year point to the necessity of adopting such measures, as, in similar cases, would advance the public interests, and at the same time, relieve the Board and other officers of the government from the assumption of an unpleasant responsibility.

It is hoped that the Legislature will perceive the necessity of making an early appropriation (in addition to the fifty thousand dollars received from the banks,) for repairs in advance of the passage of the general appropriation bill. If no such appropriation be made immediately, the public works cannot be opened for navigation at the proper period in the spring.

If no serious breaches should occur, it may be safely estimated that the receipts from the public works in 1848, will amount to one million seven hundred thousand dollars. The estimates of expenses in statement No. 2, and for expenses of motive power, amount to seven hundred and seventy-nine thousand five hundred and ninety dollars. If the estimate of receipts from tolls be realized, the net revenue, from the several lines of canal and railroad in 1848, will amount to nine hundred and twenty thousand four hundred and ten dollars.

J. HARTSHORNE,
JAMES BURNS,
J. M. POWER,
Canal Commissioners.

CANAL COMMISSIONERS' OFFICE,
Harrisburg, Dec. 30, 1847.

Extracts from the Thirteenth Annual Report of the Directors of the Western Rail-Road Corporation, to the Stockholders, January, 1848.

The Directors of the Western Railroad Corporation submit this, their Thirteenth Annual Report of the business of the Road, and their doings during the financial year, which terminated on the 30th day of November, 1847.

TRANSPORTATION DEPARTMENT.

The balance to the credit of the contingent fund, at the commencement of the year, was				$104,011·99
The income of the Road during the year has been:—				
From Passengers, ...		$502,321·92		
" Freight, ...		785,345·66		
" Mails, Rents, &c., . .		37,668·48	=$1,325,336·06	
Expenses:—				
For road repairs, ...		$196,548·63		
" Engine repairs, . . .		52,050·12		
" Car repairs, ...		72,061·03		
" Buildings, &c., . . .		34,630·86		
" Transportation expenses, .		280,623·35		
" General expenses, . . .		40,775·76	= 676,689·75	
Nett earnings, ...			$648,646·31	
From which deduct interest paid on loan, ...		$264,854·53		
One dividend of four per cent. on 35,500 shares, . .	$142,000			
One do. on 40,000 do. .	160,000	=302,000·00	= 566,854·53	
Leaving a surplus for the year of				$81,791·78
And a total surplus, Nov. 30, 1847, ...				$185,803·77

During the year, the passenger trains have run regularly and without any serious accident. No passenger has been injured. The freight trains have been less fortunate. Several accidents have occurred to these trains, whereby several brakemen have lost their lives, and a number have been badly injured. Two of the men employed upon the road have lost their lives within the past year by coming in contact with the bridges over the track. In previous years there has been a larger loss of life from this cause. The attention of the directors has been called to the adoption of measures to prevent this class of accidents, and they consider it very desirable that every bridge over the track by which brakemen are exposed to accident should be raised to a sufficient height; which they hope to accomplish, if the consent of the proper authorities can be obtained, and if the work can be accomplished at a reasonable expense.

The increase of business for the past year, as compared with the previous year, has been fifty-seven per cent. on freight, and twenty-one per cent. on passengers, making an average gain of forty-two per cent on the gross receipts.

The annexed tables exhibit as follows:—

A.

The amount received from all sources since the Road was opened.

	Passengers.	Merchandize	Mails, &c.	Total.	Expenses.	Balance of Receipts.	Miles Run.
3 months in							
1839	$13,472·94	$4,136·21		$17,609·15	$14,380·64	$3,228·51	
1840	70,820·79	38,359·78	$3,166·82	112,347·39	62,071·72	50.275·67	94,404
1841	113,841·85	64,467·14	4,000·00	182,308·99	132,501·45	49.807·54	160,106
*1842	266,446·83	226,674·61	19,566·84	512,688·28	266,619·30	246.063·98	397,295
1843	275,139·64	275,696·19	23,046·68	573,882·51	303,973·06	269,909·45	441,608½
1844	358,694·00	371,131·84	23,926·88	753,752·72	314,074·20	439,678·52	499.968
1845	366,753·02	420,717·30	26,009·83	813,480·15	370,621·25	442,858·90	530,201
11 months in							
1846	389,861·42	459,365·18	29,191·29	878,417·89	412,679·80	465,738·09	573,956
1847	502,321·92	785,345·66	37,668·48	1,325,336·06	676,689·75	648,646·31	819,010

* First year of opening through to Albany.

B.

Number of Through and Way Passengers.

	Through Passengers.			Way Passengers.					
	1st. Class.	2d Class.	Total.	1st Class.	2d Class.	Total.	Total 1st Class.	Total 2d Class.	Grand Total.
1842	15,890	2.680½	18,570½	148,500	23,366	171,866	164,390	26,046½	190,436½
1843	19,987	6,608	26,595	140,425	33,945½	174,370½	160,412	40,553½	200.965½
1844	17.016½	7,314	24,330½	140,868½	55,058½	195,927	157,885	62.372½	220,257½
1845	13,401½	5,791	19,192½	144,723	59,717½	204,440½	158,124½	65,508½	223,633
11 months in									
1846	21,033	8,799½	29,832½	165,196	70,635½	235,831½	186,229	79,435	265,664
1847	23,678	10,621½	34,299½	264,444½	89,567	354,011½	288,122½	100,188½	388,311
	111,006	41,814½	152,820½	1,004,157	332,290	1,336,447	1,115,163	374,104½	1,489,267½

C. *Number of Tons Transported.*

	Going Westward.			Going Eastward.					
	Through from Boston to Albany	All other Tonnage.	Total going West	Through from Albany to Boston.	All other Tonnage.	Total going East	Total No. of Tons moved	Equivalent No. of Tons carried one mile.	Equivalent No. of Tons carried over the whole road
11 months in									
1846	8,358	40,251	48,609	36,403	81,382	117,785	166,394	15,748,223	100,950
1847	11,962	56,554	68,516	88,438	117,737	206,175	274,691	28,037,628	179,728

Miles run by Locomotive Engines.

	Passenger Trains.	Freight Trains.	Gravel Trains, &c.	Total No. of Miles run.
11 months in				
1846	215,336	313,259	45,382	573,956
1847	236,677	513,772	68,961	819,010

F. *Table shewing the Cost of the Western, and Albany and West Stockbridge Railroads to Nov. 30, 1847.*

Heads of Expenditures.	Amount paid to Dec. 1, 1846.		Amount paid in 1847.		Total amount paid.		Total cost of both Roads.
	Western Railroad.	A. & W. S. Railroad.	Western Railroad.	A. & W. S. R. R	Western Railroad.	A. & W. S. Railroad.	
Graduation and Masonry, . . .	$3,151,039·86	$889,635·96	$95,736·90		$3,249,776·76	889,635·96	$4,324,455·43
Bridging, ...	163,736·23		21,306·48		185,042·71		
Superstructure, including Iron, . .	1,054,033·46	293,726·65	136,338·66		1,190,372·12	293,726·65	1,484,098·77
Station Buildings and Fixtures, . .	250,332·01	175,173·92	19,502·29	$1,414·24	269,834·30	176,588·16	446,424·46
Land, Land Damage, and Fencing, . .	277,006·16	204,022·99	9,002·55	6,100·00	286,008·71	210,122·99	496,131·70
Locomotives, ...	418,978·14		66,681·05		485,659·19		485,659·19
Passenger and Baggage Cars, . .	55,066·49		9,204·35		64,270·84		64,270·84
Merchandize Cars, ...	370,548·01		39,613·63		410,161·64		410,161·64
Engineering and other Expenses, . .	665,850·61	213,637·93	*175,256·73	3,523·47	841,107·34	217,166·40	1,058,273·74
	6,409,590·97	1,776,197·45	572,642·64	11,042·71	6,932,233·11	1,787,240·16	8,769,473·77

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* This item seems to require explanation. Of the amount, $173,496·92 is charged to construction account, as if it were expended this year, although such is not the fact. Under various acts of the Legislature, £899,900 sterling scrip was issued, sold, and must be redeemed at maturity, at the rate of not less than $4·80 per pound sterling. The liability of the Corporation, on account of the bonds, must therefore be stated at that rate, exhibiting a total of $4,319,520 — Up to the present year this liability only appeared on the books of the Corporation, as estimated at the value recognized by the Legislature, $4·44 per pound sterling, and the balance to the credit of exchange account. The difference between the apparent and real liability $173,496·92 is now charged to construction, it being, in fact, the difference between what was realized from construction funds, and what the Corporation must eventually pay.

Extracts from the Annual Report of the Board of Directors of the South Carolina Railroad Company, for the year 1847.

Charleston, S. C., 8th Feb., 1848.

The Board of Directors of the South Carolina Railroad Company regret that they are not able to present as favorable a statement of the operations for 1847 as the business transactions for the first six months of the year, confidently encouraged.

In October last, a revulsion in the commercial relations between the United States and Great Britain, swept like a tornado over the land, paralyzing all the monied interchanges between our cities, and extending to the Agricultural interests in the interior. Cotton, the great staple of the South, declined 5 cents per lb. in value, and this with other connecting causes, suspended for a while all the transportation of produce, excepting such as was in transitu, and on which the railroad mostly relied at that season for revenue.

The effects of this derangement in trade, cannot be more strongly presented than by the fact, that the freight lists exhibit 62,833 bales of cotton less than for the corresponding months of October, November, and December of the present year, and $49,452·88 reduction in the monied receipts for the same period, which clearly shows that all of the deficiency was in down freights, while the up freight and passage, had been reserved, but not to the augmented extent estimated, and on which, from more enlarged connexions West, confidence had justly been reposed.

Notwithstanding these sudden and unlooked for events, the gross

receipts for the year amount to - - -		$655,575·30
The current expenses to - - -		303,480·40
And the nett revenue to - - -		352,094·90
(Being a fraction less than the ratio of 47 per cent. of expenditures to receipts.)		
From this revenue, provision has been made for meeting annual interest on Foreign debt,	108,461·77	
And payment of July dividend,	93,143·75	
		201,605·52
Leaving in reserve, - - -		150,489·38

Applicable to meet in part, obligations contracted in the construction of the Camden Branch, and to permanent improvements on the Track, at Depots, at Workshops, and for increased Locomotive and Car Power. These statements show an increase in the annual receipts, notwithstanding the deficiencies in the three last, and usually most busy months, of $66,494·05, and an increase in the net revenue of $72,722·78 over the previous year of 1846.

Statement No. 3.

Gross Revenue from all sources,			$655,575·30
Total Expenditures—in Road Machinery and Transportation Departments and Contingencies,		$397,604·99	
Deduct permanent expenditures, viz :			
For Camden Branch,	$9,407·69		
" Additional Machinery in Workshops,	880·00		
" Cost of additional Box, Platform, and Baggage Cars,	56,334·00		
" Cost of materials and Machinery on hand applicable for new Cars, &c., ordered,	27,503 00		
		94,124·59	
Current expenses,			303,480·40
Net Revenue for the year,			352,094·90
Paid July Dividend,		$93,143·75	
Interest on Sterling Bonds,		108,461·77	
			201,605·52
Leaving, applicable to the permanent objects of : to-wit, Improvements of Depots, purchase of Lands, new Locomotives and Rail Iron : a balance of			$150,489·38
The net income $352,094·90 : being on the cost of the Hamburg Road; and the Stock represented in the Company, more than 6¼ per cent. for the year 1847.			
Cost of Hamburg Road,		$2,786,081·99	
Amount due State, to be vested in Bonds,		178,223·66	
		$2,964,315 65	
Stock represented in Company by 34,800 Shares at $75,		2,610,000·00	
Total original cost of Property of Road,		$5,574,315 65	

THOMAS WARING, *Auditor.*

No. 4.

Statement of the number of Passengers conveyed upon the Railroad between Charleston, Hamburg, and Columbia, with the amount received for Freight and Passage, &c., during the year 1847.

1847.	PASSAGE.						FREIGHT.			
	UP.		DOWN.		UP AND DOWN.		UP.	DOWN.	UP AND DOWN.	TOTAL AMOUNT
	NO. Pass.	AMOUNT. Passage.	NO. Pass.	AMOUNT. Passage.	NO. Pass.	AMOUNT. Passage.	AMOUNT. Freight.	AMOUNT. Freight.	AMOUNT. Freight.	Freight and Passage.
January, .	3,136	9,237·88	2,390	7,603·97	5,526	16,841·85	14,922·84	30,731·19	45,654·03	62,495·88
February, .	2.874	8,657·90	2,308	8,506·75	5,182	17,164·65	15,046·32	24,941·20	39,987·52	57,152·17
March, . .	4,615	17,396·71	2,320	8,812·04	6,935	26,208·75	25,172·85	17,221·43	42,394·28	68,603·03
April, . .	9,581	10,896·71	8,409	10,137·80	17,990	21,034·51	22,005·74	17,925·70	39,931·44	60,965·95
May, . .	2,919	8,772·34	2,425	7,383·36	5,344	16,155·70	12.779·66	13,130·48	25,910·14	42,065·84
June, . .	2,718	7,470·22	2,037	6,888·81	4,755	13,859·03	10,009·49	6,921·86	16,931·35	30,790·38
July, . .	2,202	5,727·76	2,057	5,758·51	4,259	11,486·27	7,839·59	6,135·95	13,975·54	25,461·81
August, . .	2,425	6,720·43	1,970	5,863·45	4,395	12,583·88	10,745·94	6,429·93	17.175 87	29,759·75
September, .	2,740	9,404·83	1,807	6,104·20	4,547	15,509·03	30,447·81	6,647·68	37,995·49	52,604·52
October, . .	3.561	11,960·36	2,589	8,634·16	6,150	20,594·52	26,998·06	21,839 99	48,838·05	69,432·57
November, .	3,540	11,569·93	2,467	7,963·39	6,007	19,533·32	14,906·51	13,290·15	28,196·74	47,730·00
December, .	3,634	9,479·45	2,855	8,154·35	6,489	17,633·80	10,606·33	20,937·22	31,543·55	49,177·35
Total, .	43,945	117,294·52	33,634	91,310·79	77,579	208,605·31	201,481·22	186,152·78	387,634·00	596,239·31

Income from Freight and Passage as above, . .		$596,239·31	
" " Through Tickets sold by Georgia Railroad Company, .		13,543·62	
Total Freight and Passage, .		$609,782·93	
" " Transportation of the Mails, . . .		40,050·01	
" " Negro wages, Oak wood sold, and other sources, .		5,316·86	
" " Sales of negro man "June," , . .		300·00	
" " Capital Stock, . . .	5 00		
" " Cancelled Dividends, . .	120·50		
		125·50	
Total Income for the year 1847, . .			$655,575·30

THOMAS WARING, *Auditor.*

No. 5.—Statement of the number of Bales of Cotton, &c., received in Charleston by the Railroad, from 1st January to 31st December, 1847.

Months.	Hamburg.	Aiken.	Blk'ville.	Midway.	Brch'ville.	Way H. R.	Tot. H. R.	Columbia.	Gadsden.	Lewisville	Orangb'g.	Way C. B	Tot. C. B.	G. Total.
January, - -	13,256	45	716	386	85	359	14.847	11,498	1,136	324	226	712	13,896	28,743
February, - -	10,457		534	166	44	138	11,339	6,960	680	471	191	444	8,746	20,085
March, - -	6,069	54	144	15	41	61	6,384	2,380	23	28	12	121	2,564	8,948
April, - - -	9,497	28	62	35	24	18	9,664	6,437	164	272	31	52	6,956	16,620
May, - - -	5,102	22	43	75	142	6	5,390	6,626	72	82	22	207	7,009	12,399
June, - - -	701		1	30			732	454				38	492	1,224
July, - - -	1,601						1,601	606	24				630	2,231
August, - -	2,880						2,880	1,115	58			3	1,176	4,056
September, -	1,306			41	3	10	1,360	1,334	245	240	115		1,934	3,294
October, - -	9,246	22	119	157	76	75	9,695	4,538	488	253	42	632	5,953	15,648
November, -	4.883	22	128	82	21	9	5,145	3,238	238	179	37	419	4,111	9,256
December, -	8,151	34	122	97	26	21	8,451	2,766	127	123	43	288	3,347	11,798
Total,	73.149	227	1.869	1,084	462	697	77,488	47.952	3,255	1.972	719	2,916	56.814	134.302

Flour, 19,043½ bbls. Corn, 334,761 bush.	Wheat, 4,087 bush. Turpentine, 3,186 bbls.	equal to 59,721 bales of cotton of 400 lbs. each.

Statement of the number of Packages and Pieces forwarded on the Railroad (up) from 1st January to 31st December, 1847.

Months.	*Pieces & Packages.*	*From No. of Vessels.*
January,	3,139	31
February,	3,150	22
March,	7,966	32
April,	10,315	41
May,	5,778	35
June.	3,248	28
July,	3,213	23
August,	3,858	23
September,	17,259	43
October,	19,584	43
November,	15,261	44
December,	3,122	28
	95,893	393

Statement of Articles received by the Railroad and forwarded to other places, from 1st January to 31st December 1847.

3022 Bales Cotton.
28 " Waste.
746 " Yarn.
63 " Domestics.
2 " Wool.
16 " Fur Skins.
4 " Rags.
548 " Pink Root, &c.
1050 Bags Feathers, Wax, &c.
78 " Wheat.
4 " Dried Peaches.
81 Bbls. Sundries.
6 hlf do. "
13 Kegs. "
9 Hhds. "
9 Casks. "
3 Tierces Sundries.
281 Boxes. "
16 Trunks. "
33 Packages. "
8 " Copper.
22 " Castings.
4 Bells.
1 Chair.
2 Copper Boilers.
3 Soda Founts.
103 Bars Iron.
69 Pigs "
98 Pieces Bloom Iron.
1 Lot Old Iron (16 tons.)
11 Packages Rope.

Total, 6334 Pieces and Packages.

THOMAS WARING, *Auditor.*

Niagara Falls Suspension Bridge.

The suspension bridge companies have decided on the construction of the bridge for the passage of railroad trains. The strength of the supporting cables is to be not less than 65,000 tons. The cost is not to exceed $190,000; and the work to be completed by the 1st of May, 1849. Charles Ellet, Jr., Esq., of Philadelphia, has been appointed the engineer. The bridge will be in sight both of the cataract and the whirlpool, and span the gorge by an arch of 800 feet, suspended 230 feet above the surface of the Niagara river. **Hunt's Merch. Mag.**

Large Railway Girders.

Within the last few days some interest has been excited at Witham by the arrival of some very large-sized cast-iron girders, for two of the bridges on the line. These girders, which were cast at Derby, are said to be the largest single girders which have ever been cast, with one exception; they are fifty-three feet four inches and a half in length, and weigh about thirteen tons each. **London Artizan.**

Cost of Locomotives in France.

In 1839, the price of locomotives in France was 300 francs the 2 cwt.; the price in 1847 is 225 francs. In 1839 the French workshops produced only twenty to twenty-five locomotives per annum; in 1847 the railways can obtain 300 to 400 locomotives from the workshops of Paris, Rouen, Creuzot, Mulhausen, and Arras. **Ibid.**

AMERICAN PATENTS.

List of American Patents which issued in the month of February, 1847, *with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents, in the U. S. Patent Office.*

1. For an *Improvement in Closing Doors;* Daniel Ball, Albany, Albany county, New York, February 1.

The patentee says,—"The nature of my invention consists in applying the compound lever, or knee joint, to doors, so as to close them by a weight, without the interposition of a spring or chain, which are so liable to be deranged."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the compound lever and weight, with a door, for closing the same, substantially in the manner and for the purpose set forth, without interposing a chain or other flexible fixture."

2. For an *Improvement in Attachments to Piano Fortes;* Moses Coburn, Savannah, Chatham county, Georgia, February 1.

This is for an invention similar to what is known as Coleman's Æolian attachment, the patentee having, on a hearing, proved to the satisfaction of the Commissioner of Patents, that he had made his invention prior to Coleman.

The patentee says,—"The nature of my invention consists in combining with a piano forte of any known construction, a set of metallic reeds, similar to those used in accordeons, and other instruments of a like character, said reeds being tuned to the strings of the piano forte, and being played by the same keys, so as to produce the combined effect of a wind and stringed instrument."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of a series of metallic reeds, tuned to the strings of a piano forte, in combination with said strings, so as to be played upon by the same keys that act on the strings of the piano, and at the same time; the whole being constructed as above set forth, or in any other manner substantially the same."

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3. For an *Improvement in Shower Baths;* H. H. King, city of New York, February 1.

The patentee says,—"The nature of my invention consists in constructing a shower bath, with hollow standards pierced with holes, so as to produce a jet of water on all sides, as well as the usual shower from above, which can be used separately, or in conjunction with the said shower, at will."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing a shower bath with lateral jets, formed by the vertical standard, substantially in the manner and for the purpose described."

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4. For an *Improvement in Stoves;* Charles W. Grannis, Collins, Erie county, New York, February 1.

"The nature of my invention," says the patentee, "consists in the manner of heating air and conveying it to the oven of an elevated oven stove, it being applicable at the same time to all the different forms of stoves with elevated ovens."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the air-heating apparatus with the stove and elevated oven, substantially in the manner described."

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5. For an *Improvement in hardening Hat Bodies;* Samuel Lyon, Roxbury, Norfolk county, Massachusetts, February 5.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the improvement by which I effect the hardening of a hat body, viz: by means of a conic frustrum or block, upon which the body is placed or formed, and a damp cloth applied to the fibrous matter upon the block, in combination with a hollow vessel surrounding the whole—the block having a short reciprocating motion upon its axis, imparted to it when placed within the vessel, and the whole being made to operate together, as specified.

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6. For an *Improvement in the self-adjusting Truss;* A. W. Patterson, Pittsburg, Allegheny county, Pennsylvania, February 5.

We make the following extract from the specification:

"The peculiar nature of this invention consists in furnishing the block the desirable property of always preserving a *common centre*, when any part of it is acted upon, thereby enabling it to adapt itself to any movement made by the patient, and to remain firmly fixed to the parts, whatever attitude they may take; *consequently* avoiding all liability to permit a rupture to escape from underneath it, either by displacement, or a portion of it raising from the parts to which it is applied, while its fine susceptibility to yield to any movement happily obviates the necessity complained of in wearing other trusses with wood blocks—these it accomplishes:

"1st. By a central principle of motion, which it executes by yielding centrewise, when acted upon too severely by the body spring, or other agents.

"2d. By a circular principle of motion which it performs around a common centre, when pressed laterally, to produce the same.

"3d. By a rocking principle of motion which it is enabled to perform in any direction, as exigency may require."

Claim.—"What I claim as new, and desire to secure by letters patent, is the mode or manner of producing this universal self-adjusting property of the block, combined by the three principles above explained and developed—that is to say, I claim the before described peculiar combination and arrangement of the half elliptic springs, crossed at right angles, centre pin and plate, arranged and operating in the manner and for the purpose above set forth, or any other combination and arrangement analogous thereto, producing like results."

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7. For an *Improvement in the manufacture of Tree-nails;* E. Weber and Nathan O. Mitchell, Gardiner, Kennebec county, Maine, February 5.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the revolving pinion socket, the stationary double trumpet-mouthed socket, and gouge shaped cutter, with the sliding socket and bevelled cutter, constructed, arranged, and operated in the manner and for the purpose described."

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8. For an *Improvement in Floating Sectional Docks;* Samuel Loveland, Oswego, Oswego county, New York, February 5.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combination of the air tight chambers with the large buoyant chambers, by means of the guiding gauge-posts for the purpose of regulating the degree of emersion of the buoyant chambers and the parts attached thereto when not in use, submerged entirely below the surface of the water, for protecting the same from decay."

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9. For an *Improvement in Dressing the Sides, Rounding the Edges, and Punching the Holes in Slats for Venetian Blinds;* Lott McGill, Philadelphia, Pennsylvania, February 5.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combination of the pitman, the sliding frame, the driving bar, the spring clamps, the sliding piece and the drivers connected to the same; the planes and drivers, the planes, the steel plates and guard bars between the planes, the drop guards and the planes, and the punches, arranged and operating with each other and with the other parts of the machine respectively, substantially in the manner and for the purpose set forth."

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10. For an *Improvement in the Knives of Machinery for Cutting Straw;* F. D. Sampson, East Brookfield, Worcester, Massachusetts, February 5.

Claim.—"I claim as my invention, a rentering, angular, transversal curved knife, and an elevated angular knife bar in combination with each other, and constructed and arranged with respect to the feeding trough, and operating together, substantially in the manner and for the purpose specified.

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11. For an *Improvement in the Safety Fuse for Blasting Rocks, &c.;* Richard Bacon, Simsbury, Hartford, Connecticut, February 5.

The patentee says,—"My improvement consists in providing for communicating the fire with more certainty to the charge, to effect which I insert lengthwise through the fuse and as near the centre of the powder or other combustible matter as may be, a thread saturated with a solution of nitre, sulphur, or any other combustible material or substance. To the above is the claim limited."

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12 For an *Improvement in Composition for adding to Paints;* Robert Braman, Baltimore, Maryland, February 5.

To make one gallon and a fourth of paint of a permanent and durable body:

Take one gallon of rain water,

Three pounds of gum shellac,

Three ounces of pearl ash, and put them into an iron vessel and boil them slowly over a moderate fire without stirring them until the ingredients are well incorporated.

Claim.—"What I claim as my discovery, and desire to secure by letters patent, is the before-described composition to be added to paints ground in oil or otherwise, for producing the effects described."

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13. For an *Improvement in Harness Pads;* Charles Pope, and Kasson Frazer, Syracuse, Onondaga, New York, February 5.

The nature of this invention, the patentees inform us, consists in providing the pads, which may be used in a harness or saddle, with movable joints which will allow the pads to regulate themselves to the various condition of the animal.

Claim.—"What we *claim* as our invention or improvement, and desire to secure by letters patent, consists in the combination of a joint or joints with the *pad plates* and yoke, in the various kinds of harnesses and saddles, so as to allow them to change their angle or position to conform to the shape of the back of the horse or other animal on which the same may be used."

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14. For an *Improvement in constructing Wrought Iron Cannons;* Albert Eames, Chicopee Falls, Hampden, Massachusetts, February 5.

The patentee says,—"The nature of my invention consists in a peculiar manner of connecting the staves and hoops of wrought metal cannons, by making the calibre or bore of a series of staves held together by a second series of staves, breaking joints with the first series, and embracing dovetailed or other projections on them, and then the whole bound together by hoops or rings.

Claim.—"What I do claim as my invention, and desire to secure by letters patent, is connecting together the iron series of staves by means of the outer or second series, breaking joints with the first, and embracing projections thereon, substantially as herein described. And I also claim the hoops or rings in combination with the two series of staves put and connected together in the manner herein described, whereby the whole is bound and properly secured together, as herein described."

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15. For an *Improvement in the mode of preparing the meal of flaxseed, and other oleaginous seeds, for the purpose of expressing the Oil;* Elijah Horner, East Brook, Mercer county, Pennsylvania, February 9.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of cream of tartar and sal æratus with ground flaxseed, or other oleaginous seeds, previous to the usual process of steaming, and them steaming the same, substantially in the manner and for the purpose set forth."

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16. For an *Improvement in making or setting up Hat Bodies;* Alva B. Taylor and A. B. Burr, City of New York, February 9.

This is granted for improvements on a machine patented by Henry

A. Wells, on the 25th of April, 1846, and clearly described in the list of patents in this journal.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is, first, making the sides of the trunk of thin sheet metal, or other substance, which will bend with facility and retain the form given, in combination with the movable top, for the purpose of adapting the form of the mouth or delivery aperture of the trunk, to any size or form of former, and to the regulation of the deposit, of the fibres on the former, to determine the thickness of the hat, substantially as herein described.

"Second. We claim so connecting the top of the trunk with the sides thereof, that it can be elevated or depressed at pleasure, to increase or decrease the height of the mouth or delivery aperture of the trunk, and adapt it to any size of former that may be used, substantially as herein described.

"Third. We claim the valve or shutter, in combination with the trunk, substantially as described, for the purpose of regulating or stopping the current of air through the trunk, as described. And,

"Fourth. We claim the addition of the roller or rollers, covered with cloth or other analagous substance, producing like results, in combination with the feed rollers and rotating brush, substantially as described."

17. For an *Improvement in re-action Water Wheels;* James Armstrong and Hardy Herring, Lisbon, Sampson county, North Carolina, February 9.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the frustrum of a solid cone, frustrum of a cone hoop and spiral wedge-shaped floats, substantially of the form and in the manner herein set forth, for the purpose of forming a frustrum of a cone water wheel, of the precise form and arrangement as described."

18. For an *Improvement in the Mariner's Compass;* Ralph Reeder, Cincinnati, Ohio, February 9.

Claim.—"What I claim therein as new, and desire to secure by letters patent, is the manner set forth, of combining a chronometer and a universal sun-dial, with the respective circles and arcs of circles containing the graduations for the course or points of the compass, the hours, the latitude and altitude; the respective parts being arranged and operating substantially in the manner and for the purpose fully made known; and this I claim, whether the said parts be formed precisely in the manner described and represented, or in any other that is the same in its principles and results."

19. For an *Improvement in Pneumatic Springs for rail road cars, &c.;* John Lewis, New Haven, Connecticut, February 10.

We make the following extract from the specification:

"The nature of my invention consists in applying the elasticity of atmospheric air, or any permanently elastic gas, by means of an expanding and contracting chamber, or chambers, made in one, two or more parts, and connected together by means of two or more belts of india rubber cloth, or other flexible or impermeable material, with alcohol or other liquid interposed, the more effectually to prevent the escape of the air or gas contained in the apparatus, and to aid in relieving the flexible connexion, and preventing its rupture by the action of the weight or force on the spring. This mode of connecting two vessels being applicable, without the air, to other purposes, such as hydraulic presses, &c., by forcing water into or between the two vessels. And my improvement also consists in providing this apparatus with one or more of what I denominate a *respiratory chamber*, or chambers attached to one or both ends of the apparatus, and separated from the main chamber of the apparatus by a diaphragm, or diaphragms, perforated with holes, which will check the passage of the air, and thus relieve the apparatus from the injurious effects of sudden shocks."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, the method of connecting the two vessels, composing the pneumatic spring, bumper, press, &c., by means of two or more belts, with alcohol or other liquid interposed, substantially as described, to be used for the purposes above set forth.

"Second. I claim so arranging the two vessels, and the connecting belt or belts, substantially as described, that the belt or belts shall, at all times, be sustained by either one or both of the vessels, to prevent them from being ruptured by the pressure of the contained fluid as described.

"Third. I claim dividing the space between two disks into one or more spaces by means of a perforated diaphragm, or diaphragms, to form what I denominate a respiratory chamber, (or chambers) substantially as described and for the purposes explained above.

"Fourth. I also claim making the inner periphery of the outer vessel, or the outer periphery of the inner vessel, or both, beveled or conical, so that the space between the two, in which the flexure of the connecting belt or belts takes place, shall be diminished as the pressure increases, as described, for the purpose of enabling the flexible connexion the better to resist the increased pressure, as described; and this I claim, whether used with or without the other improvements."

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20. For an *Improvement in making Barrels, Hogsheads, &c.*; T. Molinier, of France, Resident of the State of Louisiana, February 10.

"The nature of my invention," says the patentee, "consists in making cooperage generally by a mechanical process. The character of my invention consists in performing, simultaneously and rapidly, several operations which are made but successively in cooperage."

Claim.—"What I claim as my invention, and desire to secure by letters patent, are the following parts:

"1st. The combination of the revolving tools with the carriage, for preparing completely the staves taken from my press, that is, for giving said staves a required length, making their notches, and emptying their centres;—said revolving tools effecting simultaneously those three operations.

"2d. The two parts that I call "Systems of Headpieces," as described; which systems hold the headpieces of the barrel at the height of the notches with a mathematical precision, during the pressing; said systems of headpieces being furnished with spring circles, which govern the staves, and maintain them in a convenient position for the forming or making up the barrel."

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21. For an *Improvement in Wrought Iron Rails;* Thomas Grenell, Newark, New Jersey, February 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the peculiar arrangement of the saddles, and the mortice in the ends of the rail for screwing it to the sleeper, and by this peculiar fastening, I am enabled to form a rail which can be worn on both sides, by shifting the rail from track to track, and reversing the base and top as often as the wear requires it, thus bringing all the four corners to the action of the wheels, as described."

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22. For an *Improvement in the apparatus for the cure of the curvature of the Spine;* Cyrus Knapp, Cincinnati, Hamilton county, Ohio, February 13.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combining, in the manner shown, of the adjustable hip and arm pieces, by means of the adjustable standards, so as to establish an extension and counter extension of the vertebral column between the integuments of the hips, and of the axillæ; the respective parts being combined and operating substantially in the manner and for the purpose herein described and represented. I also claim the combining of the head piece with the main body of the elevator, said head piece being constructed and connected as set forth."

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23. For an *Improvement in Cutting, Threshing, and Cleaning Grain;* D. A. Church and L. O. Obert, Friendship, New York; and W. W. Willoughby and O. F. Willoughby, Chicago, Illinois, February 13.

Claim.—"What we claim as new therein, and desire to secure by letters patent, is the manner set forth of constructing the separator, so that it shall consist of separate combs, turning on pivots, in endless chains, and operating in the manner made known."

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24. For an *Improvement in Bleaching Rosin White;* Joseph W. Harman, Williamsburg, Kings' county, New York, February 20.

Claim.—"What I claim as new, and as my invention, and desire to secure by letters patent, is the mode of bleaching rosin white, by means of alkali, artificial heat, and water, combined and connected in process substantially as described, so as to extract the coloring matter from the rosin."

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25. For an *Improvement in Fire Escapes;* W. W. Van Loan, Catskill, Greene county, New York, February 20.

Claim.—"What I claim as new, and desire to secure by letters patent, is the employment of a case or tube of canvass, furnished with hooks or other devices, by which it may be attached to a window frame or other convenient support, in the manner and for the purpose herein fully made known; the whole structure and operation of said apparatus being substantially the same with that described."

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26. For an *Improvement in ascertaining the height of water in Steam Boilers;* Henry R. Worthington, City of New York, and W. H. Baker, Williamsburg, King's county, New York, February 20.

Claim.—"What we claim therein as new, and desire to secure by letters patent, is the application of the principle of percussion to that purpose, substantially in the manner fully set forth, namely, by causing a piston, or other flat surface, to strike horizontally, and with percussive force, upon the surface of the water, within a cylinder or other suitable vessel, into which steam and water are admitted from the boiler, whether under the precise arrangement herein described and represented, or under any other which is the same in principle and operation."

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27. For an *Improvement in dressing Mill Stones;* Asa Fisk, Jr., Leander D. Rumsey, and O. S. Gregory, Sullivan, Tioga county, Pennsylvania, February 20.

"The nature of our invention," say the patentees, "consists in so combining a set of cold chisels with an adjustable machine, arranged upon a frame work base and sliding carriage, that, by turning a crank with one hand, rapid motion is imparted to the chisels, and by operating other parts of the machine at the same time, with the other hand, the chisels are made to traverse the stone in such a manner as to form an even surface, or to cut the grooves in the mill stone."

Claim.—"What we claim as new, and desire to secure by letters patent, is the giving the dressing machine and chisels an inclined movement upon the sliding carriage, (corresponding with the inclined side of the furrows of a mill stone,) by means of the inclined planes, (on the side pieces of the sliding carriage,) and the projections, (on the shoe pieces of the dressing machine,) combined with each other, and with the hand wheel, the pinion, cog wheel, and rack, substantially in the manner herein set forth."

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28. For an *Improvement in Cooking Stoves;* Jas. H. Conklin, Peekskill, Westchester county, New York, February 20.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is the centre flue, between the ovens, communicating directly from the fire place to the flue back of the ovens, so that the fire shall pass between the ovens, (and not hot air simply,) and thereby producing a greater heat between the ovens, and in combination therewith, the arrangement of the flues, preserving a uniform heat around both ovens as set forth."

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29. For an *Improvement in Tailors' Sliding Scales, for cutting Coats, &c.;* Thomas Watt, Hubbard township, Trumbull county, Ohio, February 20.

The patentee says:—"The nature of my invention consists in a certain sliding pattern, or scale, marked and graduated upon the pattern, so as to be set, moved, or be adapted to any size or fashion, for the garments of coats, pantaloons, and vests."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the sliding scale and pattern, or patterns, for cutting coats, vests, and pants, by the parts aforesaid, patterns moving upon pinions and gains to any given size, in the manner herein described."

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30. For an *Improvement in Ploughs;* George Bartlett, Smithfield, Providence county, Rhode Island, February 20.

Claim.—"I claim the location of the joints near the line of draught, or, in other words, near the axis about which the plough should, and ordinarily does, revolve, when rolled, for the purpose of guiding it."

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31. For an *Improvement in Railway Switches;* Andrew Ralston, West Middletown, Pennsylvania, February 20.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combining with the central cross tie of the switch, the stud, the detaching plate, the lever, the spring, and the friction plate, with the apertures in the same, in such a manner that the forward motion of the guiding wedge, (of the form herein set forth.) secured to the front end of a locomotive, will unfasten and move the switch to the desired position, and the switch re-fasten itself again, substantially as herein set forth."

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32. For an *Improvement in Artificial Incubation;* L. G. Hoffman, Albany, New York, February 20.

The patentee says,—"The nature of my invention consists in the peculiar manner in which I construct my apparatus for hatching eggs, by heat derived from warm water."

Claim.—"I claim the oven enclosing the chest of drawers, and surrounded by a jacketing, formed by constructing the top, bottom, and sides with double plates, placed at a suitable distance apart, the internal forming a tight receptacle for water, in combination with either or both the heaters; the former being intended to operate with charcoal, or other suitable fuel, and the latter by the flame of a lamp, as herein set forth and described.

"I also claim the mode in which I have combined the brooding chamber with the oven, so as to be heated thereby, viz: by cutting out a portion of the top of the former, to receive the projecting portion of the jacketing of the latter, as herein before described.

"And I further claim the mode of throwing the waste heat of the lamp into the brooding chamber; the whole being constructed and operating substantially in the manner and for the purposes herein described."

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33. For an *Improvement in Corn Shellers;* Reuben Chalfant, West Grove, Chester county, Pennsylvania, February 27.

The nature of this invention consists in the combination of springs and the division board, between said springs, to prevent the excessive vibration of the stop holder or corn reserver, to strike, and to throw against the pin wheel, and bevel wheel, to save the same from being injured.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the springs with the division board, or stop, placed between them substantially in the manner described."

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34. For an *Improvement in Ploughs;* James H. Conklin, Peekskill, Westchester county, New York, February 27.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the share and confiner with the mould board, constructed, arranged, and operating in the manner and for the purpose set forth."

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35. For an *Improvement in Mixing and Breaking Dough;* Hosea Ball, Cincinnati, Hamilton county, Ohio, February 27.

Claim.—"I claim the combination of the breaker or worm, with the funnel and tube in the manner and for the purpose described."

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36. For an *Improvement in Shingle Machines;* William F. Fitch, Newport, Penobscot county, Maine, February 27.

The nature of my invention, says the patentee, consists in the attachment of a regulating apparatus to the shingle machine, which being properly adjusted for each bolt, will cause the rim of the carriage to correspond with the depth and length of the bolt to be sawed; so arranged that the moment the saw has separated the shingle from, or has ceased to operate on the bolt, the carriage will be detached from the feeding apparatus and run back to be reset for another shingle.

Claim.—"What I claim as new, and desire to secure by letters patent, is the regulating the run of the carriage to correspond with the depth or length of the blocks or bolts to be sawed, by means of the adjustable gauge, disk, bar, bent lever, arbor, arm, rods, adjustable cam, pinion, vibrating bar, pulleys, cord, weight, supporter, latch, and the rack, combined and operating with each other, and with the spring catch and vibrating bar, substantially in the manner herein set forth."

37. For an *Improvement in Planing, Tonguing, and Grooving Boards;* Joseph Powell, Nelson Barlow, and Edward Holden, St. Louis, Missouri, February 27.

Claim.—"What we claim therein as new, and desire to secure by letters patent, is, first, the combination of the pairs of feeding rollers, with the bed plate and the rotating reducing wheel, substantially in the manner and for the purpose herein set forth; viz: the placing the axles of the pair of feeding rollers preceding the reducing cutter wheel, and the axles of the pair of feeding rollers immediately following the same, respectively, out of a vertical line, with each other, thereby bringing the upper roller of each pair nearer to the shaft of the reducing wheel than the lower one, for the purpose of springing the board or plank to the bed plate, as herein more particularly described.

"2nd. We also claim the combination of the series of cutting disks, tonguing cutters and rollers, for the purpose of forming the tongue, on the edge of boards or plank, substantially as herein set forth.

"3rd. We also claim the combination of the cutting disks, the grooving cutters and rollers for the purpose of forming the groove in the edge of boards or plank, substantially in the manner herein set forth."

38. For an *Improvement in the manner of Conveying Wagons, and other Wheeled Vehicles, with their Loads, across Rivers and other Waters;* Henry Stanton, Washington, District of Columbia, February 27.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combining of floats made of India rubber cloth, or of other material that is water tight, and capable of being inflated, with a wagon, or other wheeled vehicle, in the manner and for the purpose herein set forth. I do not claim the use of such floats when attached to or making a part of boats, or other vessels, or floating bodies, for the giving buoyancy thereto, or for their conveyance across, or along rivers, or other waters, this application of such floats being well known, but I limit my claim as above stated, to their combination with wheeled vehicles, retaining their wheels; this being the essential feature of my improvement, and that upon which its whole novelty and utility are dependent, as it enables the wagon to pass into and out of the water, and also over shoals therein, in virtue of said combination of the floats and wheels."

39. For an *Improvement in the Manufacture of Sugar;* Antoine M. F. Chevet, Parish of St James, Louisiana, February 27.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is not an apparatus, but the application of a temperature (higher than the temperature of ebullition under the atmospheric pressure) to the sugar cane juice in order to destroy the greatest part of the matter injurious to the sugar, and using increase of pressure which results from it, for removing the liquor out of the kettle and conveying it in contact with a purifying agent (lime for example); in such a manner, the juice is protected against fire, during the defecation or purifying, and during the deposit of coagulated matters and other impurities."

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40. For an *Improvement in the Manufacture of Leather Sword-Scabbards, or various other articles of a like character;* F. Durand and O. Pecqueur, citizens of France, February 27.

This improvement consists in splitting the leather within, and leaving the edges united, and then crimping or stretching it to the required form.

Claim.—"What we claim, is the process described for making, in leather, sword-scabbards, sheaths, tubes, wrappers, and cases for fire arms, and for other purposes, without the use of gluing, cementing, or sewing, as specified."

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41. For an *Improvement in Trusses;* Halvor Halvorson, Lancaster, Worcester county, Massachusetts, February 27.

Claim.—"I claim the rotary axis plate as combined with the main spring and arm and ratchet cam wheel, and operating substantially as above specified."

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42. For an *Improvement in Washing Gold Ore;* Jonathan Sullivan, Gold Region, Moore county, North Carolina, February 27.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of washing and saving gold by a combination of the semi-rotary *and convex form* of the surface of the basins, together with the apertures for the escape of water and sand, *at their centre,* and fitted with feeding troughs as described, the whole being constructed, combined, and operating substantially as herein set forth."

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43. For an *Improvement in Hanging Carriage Bodies;* John Speed, Crawfordsville, Indiana, February 27.

Claim.—"What I claim as my invention, is the combination of the shafts, the cranks, the connecting rods, brackets and taps, substantially as above described with their application to railway and other carriages."

44. For an *Improvement in Mortising Machines;* R. and S. Fairchild, (assigned to S. Fairchild,) Trumbull, Fairfield county, Connecticut, February 27.

The patentees say,—"The nature of our invention consists in the application of a spring upon the back of the chisel, or between the chisels, permitting the chips to escape as they accumulate between the spring and chisel, thus clearing the chips from the mortice, as hereinafter more fully described."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the application of a spring in combination with chisels for mortising, for the purposes and in the manner specified."

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45. For an *Improvement in Metallic Pens;* Albert G. Bagley, City of New York, February 27.

We make the following extract from the specification:

"In my improvement I use thin strips of metal, but instead of cutting them into lengths required for pens, and then rolling the metal out and producing the barrel form by pressing the sheet metal in a die, I produce the required tenuity and barrel form by one operation, viz: by placing long strips of sheet metal upon a mandril, and drawing them through a suitable sized aperture in a draw plate. Afterward I place the barrel-shaped metal into a die, and cut it into lengths, and the shape of the pen, by the same operation."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of producing the barrel form of metalic pens, by the use of a mandril and plate, as herein set forth."

STATISTICS.

A statement of the quantity of the following articles exported from the United States to foreign countries during the year commencing on the 1st of July, 1846, and ending on the 30th of June, 1847.

This statement was prepared at the Treasury Department for the Philadelphia "Commercial List." It will be seen that the total value of exports amounts to the enormous sum of $53,262,437 in a single year. The total exports were—

Flour,	bbls.	4,382,496	Rye flour,	bbls.	48,982
Wheat,	bush.	4,399,951	Ship bread,	"	160,980
Corn,	"	16,326,050	"	kegs	31,082
Corn meal,	bbls.	948,062	Rye, oats, &c.,	value	$1,600,962

Total value of the above articles, $53,262,457

During the year 1846 the exports were—

Flour,	bbls.	2,289,476	Rye meal,	bbls.	38,530
Wheat,	bush.	1,613,795	Ship bread,	"	114,992
Indian corn,	"	1,828,063	"	kegs	25,505
Corn meal,	bbls.	298,790			

The total value of which was $15,987,156

Increase in the value of the exports in 1847 over those of 1846, $37,275,271.

Of the quantity exported in 1847, Philadelphia furnished the following quota:—

Flour,	bbls.	461,347	Wheat,	bush.	612,312
Rye flour,	"	12,557	Corn,	"	1,336,295
Corn meal,	"	294,332	Rye, oats, beans, peas,	"	12,779

Hunt's Merch. Mag.

Marine Steam Engine Building in New York.

The impetus which recent circumstances have given to steam navigation, has increased the value of labor some 20 per cent. within the last year, and the amount now employed in the construction of steam engines for ships is fully doubled. To give an idea of the extent of this business, which is now, in fact, synonymous with ship-building, it will be only necessary to state, that one establishment, Messrs. Stillman, Allen, & Co.'s Novelty Works, employ one thousand men, wholly upon marine engines: Messrs. Secor & Co. have some eight hundred; Allaire's Works, eight hundred; Pease, Murphy, & Co., the same number; and a host of other foundries, employing more or less—all of whom are maintained and supported solely by the merchant marine. Ibid.

Iron Trade of Philadelphia.

	1847.	1846.	1847.	1846.
	Pig Iron and Castings.		Wrought Iron.	
By Ches. & Del. Canal, lbs.	88,131,239	63,324,093	18,058,491	18,669,843
Delaware Canal,	47,020,021	43,193,081	327,852	106,389
Schuylkill Canal,	15,963,480	9,219,840	8,442,560	2,408,000
Reading Railroad,	14,778,510	22,343,230	20,725,040	9,372,910
Columbia Railroad,	9,146,500	2,549,600	21,506,500	9,008,100
Norristown Railroad,	10,075,520	10,288,789	3,184,320	
Total,	185,115,270	150,918,633	72,244,763	39,565,242
Equal to. in tons,	82,640	67,392	32.252	17,681
	Nails and Spikes.		Blooms.	
By Reading Railroad, lbs.	8,743,480	7,251,670	1,537,330	2,459,060
Columbia, "	7,213,700	21,500	1,323,300	7,251,670
Norristown, "		1,741,792	89,600	
Ches. and Del. Canal,	1,634,877			
Schuylkill Canal,	1,966,720	1,612,800	3,339,840	
Total,	19,558.777	10,627,736	6,290,070	9,710,730
Equal to, in tons, kegs,	8.731 195,587	6,278 101,217	2,808	4,335

Ibid.

Commerce, Revenue, Population, &c., of the United States.

The following statement of the commerce, revenue, population, &c., of the United States, from 1790 to 1847, inclusive, is derived from official sources.

Statement of the Commerce, Revenue. and Population of the United States, from 1790 *to* 1847.

Years.	Total Imports.	Imports consumed in the U. States, exclusive of specie.	Foreign merchandise exported, exclusive of specie.	Total Exports.	Imports of Specie.	Exp. specie, including American coin exported.	Tonnage.
1790 . .	$23,000,000	$22,460,844	$539,156	—	—	—	478,377
1791 . .	29,200,000	28,687,959	512,041	$19,012,041	—	—	502,146
1792 . .	31,500,000	29,746,902	1,753,098	20,753,096	—	—	564,457
1793 . .	31,100,000	28,990,428	2,109,572	26,109,572	—	—	520,764
1794 . .	34,600,000	28,073,767	6,526,233	33,026,233	—	—	628,618
1795 . .	69,756,268	61,266,796	8,489,472	47,989,472	—	—	747,965
1796 . .	81,436,164	55,136,164	26,300,000	67,064,097	—	—	831,899
1797 . .	75,379,406	48,379,406	27,000,000	56,850,026	—	—	876,913
1798 . .	68,551,700	35,551,700	33,000,000	61,527,097	—	—	898,323
1799 . .	79,069,148	33,546,148	45,523,000	78,665,522	—	—	939,409
1800 . .	91,252,768	52,121,891	39,130,877	70,971,780	—	—	972,492
1801 . .	111,363,511	64,720,790	46,642,721	94,115,925	—	—	947,492
1802 . .	76,333,333	40,558,362	35,774,971	72,483,160	—	—	892,104
1803 . .	64,666,666	51,072,594	13,594,072	55,800,033	—	—	949,172
1804 . .	85,000,000	48,768,403	36,231,597	77,699,074	—	—	1,042,404
1805 . .	120,600,000	69,420,981	53,179,019	95,566,021	—	—	1,140,368
1806 . .	129,410,000	69,126,764	60,283,236	101,536,963	—	—	1,208,736
1807 . .	138,500,000	78,856,442	59,643,558	108,343,150	—	—	1,268,548
1817 . .	99,250,000	79,891,931	19,358,069	86,671,569	—	—	1,399,912
1818 . .	121,750,000	102,323,304	19,426,696	93,281,133	—	—	1,225,185
1819 . .	87,125,000	67,959,317	19,165,683	70,142,521	—	—	1,260,751
1820 . .	74,460,000	56,441,971	18,088,029	69,691,669	—	—	1,280,167
1821 . .	62,585,724	43,796,405	10,824,429	64,974,382	$8,064,890	$10,478,049	1,298,958
1822 . .	83,241,511	68,395,673	11,476,022	72,160,281	3,369,846	10,810,120	1,328,690
1823 . .	77,579,267	51,310,736	21,170,635	74,699,030	5,097,896	6,372,987	1,336,566
1824 . .	80,549,007	53,846,567	18,322,605	75,986,657	8,379,835	7,014,522	1,389,163
1825 . .	96,340,075	66,395,722	23,793,588	99,535,388	6,150,765	8,797,055	1,423,112
1826 . .	84,974,477	57,652,577	20,440,934	77,595,322	6,880,966	4,704,533	1,534,191
1827 . .	79,484,068	54,901,108	16,431,830	82,324,827	8,151,130	8,014,880	1,620,608
1828 . .	88,509,824	66,975,505	14,044,578	72,264,686	7,489,741	8,243,476	1,741,392
1829 . .	74,492,527	54,741,571	12,247,344	72,358,671	7,403,612	4,924,020	1,260,798
1830 . .	70,876,920	49,575,099	13,145,857	73,849,508	8,155,964	2,178,733	1,191,776
1831 . .	103,191,124	82,808,110	13,077,069	81,310,583	7,305,945	9,014,931	1,267,847
1832 . .	101,029,266	75,327,688	19,794,074	87,176,943	5,907,504	5,656,340	1,439,450
1833 . .	108,118,311	83,470,067	17,577,876	90,140,433	7,070,368	2,611,701	1,606,151
1834 . .	126,521,332	86,973,147	21,636,553	104,336,973	17,911,632	2,076,758	1,758,907
1835 . .	149,895,742	122,007,974	14,756,321	121,693,577	13,131,447	6,477,775	1,824,940
1836 . .	189,980,035	158,811,392	17,767,762	128,663,040	13,400,881	4,324,336	1,882,103
1837 . .	140,989,217	113,310,571	17,162,232	117,419,376	10,576,414	5,976,249	1,896,656
1838 . .	113,717,404	86,552,508	9,417,690	108,486,616	17,747,116	3,508,046	1,995,640
1839 . .	161,092,132	145,870,816	10,626,140	121,028,416	5,575,263	8,776,743	2,096,479
1840 . .	107,141,519	86,250,335	12,008,371	132,085,946	8,882,813	8,417,014	2,180,764
1841 . .	127,946,177	114,776,309	8,181,235	121,851,803	4.988,633	10,034,332	2,130,774
1842, to Sept. 30	100,162,087	87,996,318	8,078,753	104,691,534	4,087,016	4,813,539	2,092,391
1842, 3 mos. to December 30,	21,584,599	12,431,376	1,713,112	28,115,493	7,440,112	506,936	2,174,862
1843, 6 months, Jan. to June,	43,169,200	24,862,753	3,426,223	56,230,987	14,880,223	1,013,861	2,158,603
1844 . .	108,435,035	96,390,548	6,214,058	111,200,046	5,830,429	5,454,214	2,280,095
1845 . .	117,254,564	105,599,541	7,584,781	114,646,606	4,070,242	8,606,495	3,447,002
1846 . .	121,691,797	110,048,859	7,865,206	113,488,516	3,777,732	3,905,268	2,562,085
1847 . .	146,545,638	116,258,316	6,166,039	158,648,622	24,121,289	1,907,739	2,839,046

Years.	Population.	Years.	Population.	Years.	Population.
1790	3,921,326	1810	7,239,903	1830	12,866,620
1800	5,319,762	1820	9,654,596	1840	17,069,453

Ibid.

Statement showing the value of Cotton, and other Domestic Produce, exported from the United States, from 1790 *to* 1807; *derived from the Treasurer's Department, Washington, December,* 1*st*, 1847.

Years	Value of Cotton exp.	Other domestic produce ex.	Total exports.	Years	Value of Cotton exp.	Other domestic produce exp.	Total exports.
	Dollars.	*Dollars.*	*Dollars.*		*Dollars.*	*Dollars.*	*Dollars.*
1790	58,000	19,608,000	19,666,000	1800	4,984,000	26,856,903	31,840,903
1791	52,000	18,458,000	18,500,000	1801	9,160,000	38,277,204	47,473,204
1792	41,428	18,958,572	19,000,000	1802	5,225,000	31,483,189	26.708,180
1793	160,000	23,840,000	24,000,000	1803	7,809,000	34,396,961	42,285,961
1794	550,000	25,950,000	26,500,000	1804	7,620,000	33,847,477	41,467,477
1795	2,281,250	37,218,750	39,500,000	1805	9,276,666	33,110,336	42,387,002
1796	2,226,500	38,537,597	40,764,097	1806	8,250,000	33,003,727	41,253,727
1797	1,292,000	28,558,206	29,850,206	1807	14,233,000	34,466,592	48,699,592
1798	3,639,999	24,867,098	28,527,097				
1799	4.180,000	28.962.522	33,142,523		81,074,843	530,411.134	611,485,977

Ibid.

Production of Silver in Spain.

On the old continent, Russia is not the only State which has increased its production of precious metals. The progress has been almost general among such of the European States as possess them.—The success which Russia has obtained, has been striking—incomparable. Nevertheless, it will be seen that some other nations have also made progress worthy of being cited. At the commencement of the century, Europe, without counting Russia, (which we here take in its whole extent, both to the east and west of the Oural Mountains,) yielded, in pure metal, 1300 kilogrammes of gold, and 52,670 kilogrammes of silver. In 1835, the quantity of gold was about the same, but the production of silver was increased by about 15,000 kilogrammes. The production of gold and silver in Europe was, in 1835, as at the commencement of the century, concentrated in Germany, and in the lower part of the valley of the Danube—that is, to speak more precisely, in the Hartz Mountains, in Hanover; in those of Erzgebirge, which are divided among Saxony, Bohemia, and Prussia, in Hungary and Transylvania—the last two countries, let us repeat, having pretty nearly the monopoly of gold. Out of Germany, and the valley of the Danube, there was not produced in 1835 more than 10,000 kilogrammes of silver, of a value of about 2,000,000f., and from 20,000 to 25,000 kilogrammes of gold. Industry, which, since 1835, has taken a great extension in Europe, has paid more attention to the precious metals than it had previously done. At present, only little is wanting to make the production of silver double what it was in 1835.—The principal cause of this development is, that Spain, which possesses important silver mines, formerly very celebrated, has again begun to work them.

The mines of gold, and particularly of silver, in Spain, have enjoyed great celebrity. Strabo, whose exactitude is better appreciated every day, states the fecundity of them. Long before him, the prophet Ezekiel had signalized it in his threatening prophecies against Tyre. The deposits of silver in the peninsula were worked with success under the Moors, as under the Romans. Since the country has had more liberty, the working has been resumed; and, at the same time, the numerous beds of coal, with inexhaustible mines of iron, which nature has placed in the Asturias, close to the sea, have begun to be worked with vigor.

The mines of lead, containing silver, situated in the kingdoms of Murcia and Granada, at a short distance from the Mediterranean, are those which formerly yielded, and still yield, a great quantity of silver. The lead, however, is not always associated with silver. The mines of Sierra de Gador, situated behind Almeria, which have yielded as much as 39,000,000 kilogrammes of lead, and still yield from 13,000,000 to 14,000,000 kilogrammes, do not contain silver; but the mines which are behind Carthagena, particularly at Almazarron, and still more particularly those that are worked in a little vale, called the Baranco Jaroso, in the Sierra Almagrera, in the kingdom of Granada, have a yield of silver very remarkable, being 1 per 100 with respect to the lead. Having been successively visited by several very intelligent French engineers, the mines of the South of Spain were, in 1845, worked anew by Mr. Pernolet, director of the mines of Pouliaouen, in Brittany. According to this gentlemen, the single mines of the Sierra Almagrera yield, at present, at least 40,000 kilogrammes of silver; and consequently, the total extraction of the whole peninsula cannot be estimated at fewer than 50,000 kilogrammes. Ibid.

Extracts from the Report of the Bureau of Topographical Engineers, in reference to the Commerce of the Lakes and Western Rivers; made through the Secretary of War to the U. S. House of Representatives—January 6th, 1848.—(*Executive Doc. H. R., No* 19, 1*st Sess.* 30 *Cong.*)

Consolidated return of exports and imports of the lake harbors for the year 1846.

Oswegatchie (district)	$ 180,555·00
CHAMPLAIN.	
Whitehall	6,327,489·00
Plattsburgh (district)	1,160,844·00
Burlington (district)	3,777,726·00
ONTARIO.	
Sackett's Harbor (district)	2,735,091·00
Dexter (port)	484,575·00
Salmon River or Port Ontario	423,724·00
Oswego	9,502,980·00
Big Sodus	39,206·00
Rochester	212,926·00
Pultneyville	20,342·00
Niagara (district)	606,863·00
Carried forward	25,472,321·00

Brought forward,	$25,472,321·00
ERIE.	
Black Rock	not known.
Buffalo (port)	48,989,116·00
Silver Creek	not known.
Irving	not known.
Portland	not known.
Conneaut (port)	380,475 00
Ashtabula (port)	715,467 00
Fairport (Grand River)	819,584·00
Cleaveland (port)	12,559,110·00
Huron	not known.
Sandusky (district)	5,943,127·00
Monroe (district) including Toledo	9,519,067·00
Detroit	8,706,348·00
Erie	6,373,246·00
Dunkirk	not known.
Black River (port)	215,040·00
Vermillion (port)	137,770·00
MICHIGAN.	
Chicago	3,927,150·00
St. Joseph	not known.
Grand River	“
Kalamazoo	“
New Buffalo	“
Michigan City	“
Mouth of Calumie	“
Little Fort	“
Southport	“
Racine	“
Milwaukie	“
Sheboygan	“
Manitowoc	“
	$123,829,821·00

There are several places of notoriety on the lakes enumerated in the above statement, but of which the exports and imports for 1846 are not known, because no returns have been received from them, or because the returns which have been received were too defective to be used. The foregoing amount may, therefore, be considered as below the true representation of the entire American lake commerce, and may be taken with safety as not an exaggerated value of that commerce. But there can be no doubt that the total exports and imports of these lakes, as represented in the above table, is a duplicate commerce—the exports of one place being the imports of another; it must not, however, be supposed as including a mere carrying trade, but as exports fairly shipped at a place, and as imports unloaded, and not being again involved as a part of the lake commerce. Applying these considerations to the amount of commerce above stated, they will justify the assumption of half that amount as the net moneyed value of the lake commerce; or, in other words, that the net value of this commerce is, for the year 1846, $61,914,910. The same reasoning applied to the commerce of 1841 will make it, for that year, $32,913,011; showing the lake commerce to have nearly doubled itself in five years, and to have experienced an annual average increase of 17$\frac{62}{100}$ per cent.

Extent of Steam Navigation on the Western Waters, including the rivers, bayous, &c., connected with the Mississippi by channels navigable for steamers. (From the same Document.)

The whole steamboat navigation of the Mississippi and its tributaries can be stated at 16,674 miles, as will be seen from the following table, furnished by Lieutenant Colonel S. H. Long, of the corps of topographical engineers:—

MISSISSIPPI AND ITS BRANCHES, BAYOUS, &C.

	Miles.		Miles.
Mississippi Proper	2000	Spring	50
St. Croix	80	Arkansas	600
St. Peter's	120	Canadian	60
Chippeway	70	Neosho	60
Black	60	Yazoo	300
Wisconsin	180	Tallahatchee	300
Rock	250	Yalabusha	130
Iowa	110	Big Sunflower	80
Cedar	60	Little Sunflower	70
Des Moines	250	Big Black	150
Illinois	245	Bayou de Glaze	90
Maremec	60	Bayou Care	140
Kaskaskia	150	Bayou Rouge	40
Big Muddy	5	Bayou La Fourche	60
Obion	60	Bayou Placquemine	12
Forked Deer	195	Bayou Teche	96
Big Hatchee	75	Grand River	12
St. Francis	300	Bayou Sorrele	12
White	500	Bayou Chien	5
Big Black	60		

MISSOURI AND BRANCHES.

Missouri Proper	1800	Kansas	150
Yellow Stone	300	Osage	275
Platte River	40	Grand	90

OHIO AND BRANCHES.

Ohio Proper	1000	Kentucky	62
Alleghany	200	Salt River	35
Monongahela	60	Green	150
Muskingum	70	Barren	30

	Miles.		Miles.
Kenhawa	65	Wabash	400
Big Sandy	50	Cumberland	400
Scioto	50	Tennessee	720

RED RIVER AND ITS BRANCHES, BAYOUS, &C.

Red River Proper	1500	Tensas River	150
Wachita	375	Lake Bistenaw	60
Saline	100	Lake Caddo	75
Little Missouri	50	Sulphur Fork	100
Bayou De Arboune	60	Little River	65
Bayou Bartholomew	150	Kiamichi	40
Bayou Bœuf	150	Boggy	40
Bayou Macon	175	Bayou Pierre	150
Bayou Louis	30	Atchafalaya	360

Total extent of Steamboat Navigation, 16,674

Extent of Lake Coast in the different States and Territories.

Lake Champlain is - . -	105	miles	long.
Its greatest width - .	12	"	
Its average width - - -	8	"	
Lake Ontario is - - -	180	"	"
Its greatest width - - -	52	"	
Its average width - -	40	"	
Lake Erie is - - - -	240	"	"
Its greatest width - -	57	"	
Its average width - - -	38	"	
Lake St. Clair is - - -	18	"	"
Its greatest width - - -	25	"	
Its average width - -	12	"	
Lake Huron is - - -	270	"	"
Its greatest width (not including the extensive bay of Georgian, itself 120 miles long, and averging 45 wide) is - -	105	"	
Its average width - -	70	"	
Lake Michigan is - - -	340	"	"
Its greatest width - -	83	"	
Its average width - - -	58	"	
Lake Superior is - - -	420	"	"
Its greatest width - - -	135	"	
Its average width -	100	"	

MECHANICS, PHYSICS, AND CHEMISTRY.

Account of the Experiments to determine the Principal Laws and Numerical Data, which enter into the Calculation of Steam Engines, by M. V. Regnault.

SECOND MEMOIR.

On the Determination of the Density of Gases.

(Continued from page 283.)

The common method of determining the density of a gas consists in weighing a glass globe of great size:

1st. When the globe contains perfectly dry air of a known temperature, and under a known atmospheric pressure:

2d. After having exhausted it by means of the air-pump, so that the enclosed air exerts only a very feeble pressure, which, as well as the corresponding temperature, is noted:

3d. After having filled the globe with the gas perfectly purified, the atmospheric pressure and temperature being again noted:

4th. After having again exhausted the globe, noting, as before, the pressure and temperature.

By which four weighings, and their accompanying observations of pressures and temperatures, all the data necessary for determining the density of the gas are given. But this method requires the exact knowledge of several elements, the determinations of which present generally great uncertainty.

In the first place, the temperatures which the air and the gas present at the moments of closing the globe, must be very exactly known; but the method generally used of having a thermometer placed near the globe is very defective; the temperature indicated by the thermometer may be totally different from that of the air in which it is bathed, and still more so from that of the gas which fills the globe.

MM. Dumas and Boussingault, who have lately (Ann. de Chem. et de Phys., 3d series, Vol. III, p. 270) very successfully endeavored to determine the densities of certain gases, place the thermometer, intended to indicate the temperatures of the gases. in the very centre of the globe, and for more security, they cause that temperature to be almost constant, by placing the globe in an inclosure formed by a large cylindrical vessel of zinc with double walls. The annular space left between the walls is filled with water at a temperature differing but little from that of the surrounding air. With this arrangement, we may admit that the temperature of the gas is known with sufficient accuracy.

But the greatest uncertainties exist in the weighings of the globe; for we must weigh the globe in the air, and, to have its true weight, we must add to its apparent weight, that of the air which it displaces. And, in certain cases, this latter weight is greater than that of the gas which fills the globe, so that it must be known with at least equal exactness.

We are, up to a certain point, masters of the gas which we pass into the globe. We may prepare it so as to be sure of its purity; but it is not so with the external atmosphere; we are obliged to take it as it is. In a close chamber the air may change its composition very perceptibly; its temperature, and the quantity of moisture which it contains, vary incessantly. MM. Dumas and Boussingault thought that they had completely avoided the errors arising from this source, by placing below their balance a large chest lined with lead, in which the globe suspended from one of the scales of the balance floats. A very sensitive thermometer is placed in this chest, and gives the temperature of the air. This arrangement is certainly far preferable to allowing the globe to hang freely in the air of the room; the globe suspended in the chest is kept from the currents of air which render the weighings very uncertain, and the temperature of the air in which it is placed changes but slowly; but it does not do away with the errors arising from the changes in the composition of the air, and these are by no means negligable, especially when we are working with very light gases, such, for instance, as hydrogen.

At the same time that MM. Dumas and Boussingault were weighing gases, M. Regnault was also engaged in the determination of the density of steam under different pressures, and especially under very feeble pressures. He was struck with the uncertainties which the ordinary methods of weighing gases present, especially owing to the alteration of the density of the surrounding air, which seems to have attracted but little attention from men of science, and he was led to a method which presents a degree of certainty and precision which those heretofore used do not offer.

He avoids completely, and by a very simple artifice, the uncertainties which arise from the changes in the air in which the globe is weighed. In place of equipoising it by means of weights on the opposite scale, he balances it by means of a second hermetically sealed globe of the same kind of glass, hung from the opposite scale. All the variations which take place in the air then affect the two globes in the same way, whether they arise from changes of temperature, barometric pressure, or composition of the atmosphere. It is not, therefore, required at the moment of weighing to watch the thermometer, barometer, and hygrometer; it is sufficient to wait until the two globes are in equilibrium of temperature, and when this is the case, it continues indefinitely. We have, in consequence, a very definite character by which to know when to read the weighings. This method presents also another advantage, that is, of avoiding the error arising from the different amount of moisture deposited upon the globe during different weighings. As the globes are made of the same glass, and equally dried before the commencement of the experiments, they may be assumed to condense the same amount of moisture when bathed in the same air, and, consequently, will remain in equilibrium.

The globes had a capacity of about 10 litres (2·2 gallons.) The globe in which the gas is to be weighed has a stopcock adjusted to it, so that it may be exposed to the temperature of boiling water without leakage. It is weighed when full of water, first in the air, and afterwards in water of the same temperature as that which it contains; thus is obtained the weight of water displaced by the globe.

The balancing globe is so selected that the weight of water displaced by it is rather less than that of the first, even after the addition of its metallic mounting by which it is hermetically sealed, and hung from the opposite balance scale; there is then added to it a glass tube of such capacity as that the weight of water displaced by it shall just make up the difference.

Before closing the second globe, a quantity of mercury was introduced into it so as to render it about 10 grammes (154·38 grains troy) heavier than the other. The two globes thus adjusted were submitted to several tests, in order to be sure that they satisfied the required conditions; they were left hanging for fifteen days under the balance scales, and the equilibrium was rigorously maintained all this time, although in the interval the temperature of the air had changed from 0° to 17°, (32° to 62·5° Fahr.,) and the barometric pressure from 741 to 771 millimetres (29·6 to 30·8 inches.) The general mode of operating was as follows:—A vacuum as complete as possible being made in the globe, it is placed in communication with the apparatus for producing the gas whose density is to be determined, and the stopcock is opened in such a way that the gas in the apparatus preserves a slight excess of pressure. When the globe is filled with gas, it is again placed in communication with the air-pump, a very perfect vacuum made, and it filled a second time with the gas. In order to avoid any correction for temperature, a correction which would require the knowledge of the coefficient of dilatation of the gas, and that of the globe, the globe is placed in a zinc cover and completely enveloped in melting ice. Before closing the globe, it is placed in direct communication with the atmosphere, so that the gas may place itself in equilibrium with the exterior pressure.

The globe taken out of the ice is carefully washed and dried, and hung from the scale of the balance. It requires a long time, often more than two hours, for the globe to take exactly the temperature of the surrounding air, and for its surface to cover itself with its normal amount of moisture. The balance used was able to appreciate with certainty a half milligramme when charged with one killogramme upon each scale.* It was placed over a large chest, such as used by MM. Dumas and Boussingault. At the end of the weighing, the observer did not approach the balance, but observed the oscillations of the index at a distance, with a telescope.

M. Regnault then notices the electric effects produced by wiping the globes, and the effects upon the weighings; he avoided it by wiping the globes with a napkin dipped in distilled water, and tested them by the gold-leaf electrometer. The pressures were measured by an apparatus which he describes under the name of a barometric-manometer.

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* That is sensible to one four millionth of the total load. Quere, whether this sensibility was determined after the globes had been hanging from the scales, and the balance in action for fifteen days? F.

It consists of two tubes, one of which is an ordinary barometer of 20 millim. (0.8 in. diameter,) made very carefully; the other is a glass tube of the same diameter, which may, by a lead tube, be connected with the vessel in which pressures less than that of an atmosphere are to be measured; they plunge below into a cistern of mercury having a partition, so that the two instruments may be separated at pleasure by drawing off the mercury in the cistern of the manometer below the top of the partition; this is necessary during the exhaustion of the globe, and the re-admission of the gas, for these operations produce such great oscillations in the barometer as to introduce small quantities of air into the instrument, and thus vitiate the vacuum. The exhausted globe is weighed with the precautions what have been indicated. If P represent the weight of the gas when the barometer stands at H, and p that weight when the elastic force in the globe corresponds to a barometric height h, the weight of the gas at 0°, and under the normal pressure of 760 mm., is,

$$\left(P - p\right)\frac{760}{H - h}$$

To obtain a new weighing of the same gas, the exhausted globe, enveloped in ice, is placed in connexion with the apparatus for generating the gas, and the series of operations which have been pointed out, repeated. The gas thus becomes purer at each operation. M. Regnault found that it is only from the fourth filling that the gas presents rigorously the same weight. It is desirable to satisfy one's self whether the gas upon which we are operating follows the law of Mariotte, at pressures below those of the atmosphere; this verification is absolutely necessary if the density of the gas is to serve for the determination of atomic weights. For the law of the volumes of gases, and the simple ratios which exist between their densities and atomic weights, exist rigorously only *at the limit*, that is, in a state of extreme dilatation; we must therefore see whether the anomoly in these laws does not commence already near the atmospheric pressure.

This is done by measuring the weight of the gas, with great care, at different degrees of elastic force, as marked by the comparison of the manometer and barometer.

Finally, by this means we may determine the weight of the gas which fills the globe at the temperature of 100° and under atmospheric pressure, and thus determine the density of the gas when compared with air at 100°. This new density must be exactly the same as that calculated for 0°, in order that it may serve in the calculation of the atomic weights; for it is necessary for this purpose that the gas should have the same coefficient of dilatation as the atmospheric air; at all events the weight of the gas which fills the vessel at 100° compared with that which fills it at 0°, permits us to calculate the *coefficient of dilatation of the gas.**

Again, in order to determine whether the gas follows the law of Mariotte, at the temperature 100°, we have only to repeat the former experiments, filling the globe at this temperature, instead of at 0°.

*This is the only direct method which can be used for this determination, in gases which attack mercury.

M. Regnault then recapitulates the advantages of this method, which are, that it gives the density of the gases with more precision, and far less trouble, than the methods formerly used; it gives these densities at identical temperatures at 0° and 100°, that is, at the fixed points of the thermometer; and, consequently, gives immediately the coefficient of dilatation of the gas; and, finally, it permits us to determine with great exactness, whether the gas follows the law of Mariotte, at the temperatures of melting ice, and boiling water.

He then proceeds to give the detail of all his experiments, without a single exception, in order to allow the reader to judge of the degree of precision obtained by this method. It is not necessary that we should give these details—or those of the processes by which M. R. purified his gases, they were such as might be expected from one so familiar with all the minutiæ of physical science.

He first determined by nine experiments the weight of pure atmospheric air, freed from carbonic acid and watery vapor, which filled his globe at the temperature of 0°, and under the barometric pressure of 760 millim. (29·944 inches). The mean of these experiments was 12·7781 gr. The minimum, 12·7744. The maximum 12·7809. The difference 0·0065 or $\frac{1}{1977}$, very nearly $\frac{1}{2000}$ of the mean; and he remarks that it is probable that a great part of this error is due to the variations which occur in the composition of the atmosphere. He regards it as unfortunate that men of science should have selected the atmospheric air, whose constitution is known to vary, as the standard of densities for gases, in place of some gas which could always be obtained perfectly pure, such for instance as oxygen, which would be the more convenient since this gas is already chosen, as the basis of the tables (adopted by continental chemists) of chemical equivalents.

Founded upon this determination of the weight of a given volume of air, he proceeds to determine the densities of different gases, and his results are as follows:

	Tem. at 0° Bar. 760 m	Minimum.	Maximum	Difference.
Nitrogen, Mean of 6 Experiments,	0·97137	0·97108	0·97155	$\frac{1}{2000}$
Hydrogen, “ 3 “	0·06926	0·06923	0 06932	$\frac{1}{770}$
Oxygen, “ 3 “	1·10563	1·10561	1·10565	$\frac{1}{3000}$
Carbonic Acid. 5 “	1·52910	1·52900	1·52915	$\frac{1}{1020}$
“ at 0° and 374·13 millim.	1·52366			
“ “ 224·17 “	1·52145			
“ 100° 760·00 “	1·52418			
“ “ 383·39 “	1·52410			

Densities determined by Dumas and Boussingault.

Nitrogen, from - -	0·970	to	0·974
Hydrogen, “ - -	0·0691	“	0·0695
Oxygen, “ - -	1·1055	“	1·1058

If we calculate the theoretic density of carbonic acid gas, admitting for the atomic weight of carbon 75, (oxygen = 100, or 6 if hydrogen = 1,) lately found by M. Dumas, we get the number 1·52024, which approaches the density found for this gas under the pressure of 224·17 millim. (less than nine inches.)

The density found at the temperature 0° and normal atmospheric pressure leads to an atomic weight for carbon 76·6 which, approaches very nearly the number 76·44 (6·1152, if hydrogen = 1) which chemists for a long time admitted from the experiments of M. Berzelius.*

We see, by this example, how much circumspection is necessary in deducing the value of the atomic weight of a gas from its density.

Three experiments to determine the coefficient of dilatation of the air between 0° and 100°, gave as the result 0·03663, which differs but little from the value obtained in the first memoir.

An attempt to verify the law of Mariotte, showed slight differences in which the weights, by experiments, were always a little lower than those got by calculating the density by means of Mariotte's law from the observed elastic force, but these differences were always within the limits of the errors of observation.

The coefficient of dilatation of carbonic acid gas between 0° and 100° was determined to be 0·003719. (In the first memoir, the determination by the method V, in which the gas preserved the same elastic force at 0° and 100°, as in the present case, was 0·0037099.)

The experiments to determine whether carbonic acid gas obeys the law of Mariotte at pressures less than that of the atmosphere, gave the following results,

				By experiment.	Calculated by Mariotte's law.
Weight of the gas at	0°,	and with an elastic force	224·17 mm.,	5·7345 gr.,	5·7634 grs.
"	"	"	374·13 "	9·5845 "	9·6628 "
"	101·01°	"	338·39 "	6·3549 "	6·3545 "

so that it appears that carbonic acid gas deviates notably from the law of Mariotte at ordinary temperatures, but conforms to it with the limits of experimental errors at 100°.

(To be Continued.)

ERRATA.

In the March number of our Journal, page 12, line 4, for minimum, read maximum.
Line 5, for maximum, read minimum.
" " for 1·36812, read 1·36612.

On the Power of Low Pressure Steam in Charring Animal and Vegetable Matter, and on the reducing power of Charcoal at that temperature. *By* William Ferguson, Esq.

An unsound steam-engine boiler having been covered with patent felt, to prevent radiation from its surface, the felt was observed, at the expiration of five or six months, to have become charred wherever the steam made its escape through the cracks of the boiler, whilst those parts of the felt which remained dry, although exposed to the same heat, were perfectly unaltered. The boiler was worked under a pressure of 6 lbs., which corresponds with a temperature of 232° F., but the temperature of the escaping steam and of those parts of the felt in contact with it, was 212° F. Another instance in which wood had been charred was observed in the float-gauge of a brewing-copper, which had been exposed during five years to the vapor and the saccharine solution, at a temperature not exceeding 215° or 216° F. The charcoal in this case was permeated by a soluble salt of copper, and the interstices were filled with octahedral and dedocahedral crystals of metallic copper. The author concludes, from the odor of pyroligneous acid which was perceptible, that acetic acid was formed by the decomposition of the wood, and that this united with the copper to form an acetate, which even at the temperature of 216° F., was partially reduced to the metallic state, whilst in intimate contact with the porous charcoal. **Lond. Jour. Chem. Soc.**

White Paint Manufactured from Antimony.

At the Liverpool Polytechnic Society, Mr. J. A. Forrest described a new mode of manufacturing white paint of an excellent body, superior to that manufactured from lead. It is made from oxide of antimony, and has many advantages. He had ascertained, that though it was now high in price, were there a demand for antimony, that metal could be obtained in abundance at about £12 a ton, whereas the lead used costs £24 10s. The new paint was, consequently, much cheaper; it was not so apt to lose its color, and would spread over a much larger surface than an equal weight of the paint manufactured from lead. **Civ. Eng. & Arc. Jour.**

New Method of Making Chloroform.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

MM. Huraut and Larocque recommend a modification of Soubeiran's method for the preparation of chloroform; which material, they think is likely to prove useful in the arts owing to its power of dissolving notable quantities of such substances as caoutchouc, shellac, gum copal, while on the other hand it also dissolves easily, bromine, iodine, the essential oils, the vegetable alkalies, the fats, &c.

They proceed as follows: they take 35 litres (about 9¼ galls. U. S.) of water, and bring it to a temperature from 97° to 104° Fahr. They then stir into it 5 kilogrammes (11 lbs.) of lime previously slacked, and 10 kilogrammes (22 lbs.) of the chloride of lime of commerce: they then pour in 1½ litres (1½ qts.) of alcohol of spec. grav. 0·85: then, when they are thoroughly mixed, the joints of the apparatus are luted, and the mixture brought to boiling. The operation is carried on, and the chloroform separated as usual. Only in place of distilling the liquors which swim upon the chloroform, as M. Saubeiran recommends, they are preserved for a subsequent operation, which is commenced immediately. For this, without removing any thing from the retort, introduce into it, 10 litres (3 galls.) of water, and when the liquor has again reached the temperature of 97°—104°, add from 3 to 4 kilogrammes (6½ to 9 lbs.) of lime, and 10 kilogrammes (22 lbs.) of chloride of lime, add but 1 litre (1 quart) of alcohol, and after stirring them well together, add the liquors from which the chloroform of the preceding operation was separated, and proceed as before. With an alembic of sufficient size, a third, and even a fourth operation may be gone through in the same way.

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* Berzelius himself now acknowledges the error of his former determination, and fixes the atomic weight of carbon at 75·12 or 6·01 (H = 1) which amounts to an admission of Dumas' determination. (Berzelius Traité de Chimie, Seconde Edition Française, Paris, 1845, tom. 1, p. 263.) F.

Operating in this way, MM. Hurant and Larocque obtained from 4½ litres (1⅕ galls.) of alcohol of spec. grav. 0·85—

By the First	Distillation,	550	grammes of	chloroform,
Second,	"	640	"	"
Third,	"	700	"	"
Fourth,	"	730	"	"
		2620	"	"

or about 5¾ lbs. of chloroform, which at the cost of materials and labor and pains, would make it cost about 14 francs per kilogramme ($1·27 per lb.)

They observed in the course of their experiments, what M. Souberain had before remarked, that the more rapidly the operation is conducted, the greater the quantity of chloroform produced. Hence the water is heated before the chloride of lime is introduced. The swelling of the mass, which is considerable in the old method, is scarcely sensible in this when conducted over a water bath and in the presence of lime, and the chloroform produced is, when the operation has been properly conducted, entirely free from chlorine. They also remark that wood-spirit, although it gives rather more product than alcohol, is not so advantageous, on account of its higher price and the disagreeable odor which it communicates to the chloroform.

Comptes Rendus de l'Acad. des Sci., Jan., 1848.

Notice of Explosions of Gas happening in Metallic Mines. By M. A. Dubree.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The explosions of gas, unfortunately so frequent in coal mines, have not heretofore, been mentioned, at least to my knowledge, in metalliferous deposits. I therefore publish a record of several accidents of this kind which have happened in the metallic mines of Alsace.

One of these mines, that of Gundershoffen (Lower Rhine) was sunk upon a deposit of pisolithic iron ore; the bed of the ore, which is situated at the depth of 19 metres, (62⅔ yards) lies upon the marls of the upper lias. After several inflammations of the gas, without serious consequences, one occurred in 1824, which severely burned several of the miners. At Winckel, (Upper Rhine) in a deposit similar to the above, but resting upon the upper beds of the Jurassic limestone, an explosion took place in 1832, and another inflammation much less violent, on the 27th of June, 1846. Finally the gas also took fire in March, 1846, in the veins of copper pyrites worked near Giromagny.

From the circumstances mentioned in the notice, which I have the honor to present to the Academy, it appears that the inflammable gas of these iron mines, is the proto-carburet of hydrogen, which, in the two first localities emanated from certain bituminous beds of the lias and oolite upon which the deposits of Gundershoffen and Winckel rest, and rose through fissures in the works. At Giromagny the gas probably came from the transition strata which enclose the vein.

Ibid.

On the use of Gun Cotton in Blasting. By M. Combes.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The analysis by Pelouze of the products of combustion of gun-cotton &c., *(pyroxyle) (Comptes Rendus de l' Acad. des Sciences de Paris, 2 January,* 1847,*)* gave the following results:

46 volumes of Carbonic Oxide.
1 " Carbonic Acid.
10 " Nitrogen.
34 " Vapor of water.

Whence, M. Combes remarks, it follows that it does not, like good gunpowder, contain sufficient oxygen for its complete combustion, and its deflagration gives rise to a large amount of carbonic oxide, a gas both very inflammable and very poisonous. In a series of experiments, which he made under the orders of the French government upon the use of gun-cotton in blasting, he ascertained experimentally the presence of this gas by applying a light to the gases which issued from the crevices in the rock after the explosion, which he found to burn with the peculiar blue flame peculiar to carbonic oxide, and after a while to explode by the mixture of this gas with the atmospheric air. To remedy this inconvenience he mixed roughly in his hand, 100 parts by weight of gun-cotton, with 80 of chlorate of potassa, enclosed the mixture in cartridges, and charged with 900 grammes, (2 lbs.) a blast which, according to the workmen, ought to have received 3 kilogrammes (6½ lbs.) of blasting powder. The blast produced an effect at least equal to that which this much common blasting powder, or 5½ lbs. of gunpower, or its own weight of pure gun cotton would have produced, judging by the effects of the blasts upon the same rock. The gas which issued from the crevices in the rock was not inflammable, and the explosion was not accompanied by any smell, smoke, or visible vapor, while, when gun cotton alone was employed, the vapor of water was plainly visible by its condensation, and there was a faint peculiar smell. As, however, the chlorate of potassa is an expensive salt, and it is moreover to be feared, that its use when mixed with gun cotton would be dangerous, M. Combes, proceeded to experiment upon a similar mixture of 80 parts by weight of nitrate of potassa, (common nitre) or 70 of nitrate of soda, (cubic nitre) with 100 of gun cotton. In a great number of experiments these mixtures gave constant results; entire absence of smoke and smell, as well as of inflammable gases after the explosion; and blasting effects nearly as great as were obtained with the mixture of gun cotton with chlorate of potassa; that is to say the mixture of gun cotton and nitre in the proportions indicated, produced very nearly the same effect as its own weight of gun cotton, two and three quarter times its weight of gun powder, or three and a quarer times its weight of ordinary blasting powder.

The experiments were made upon the gypsum rock, near Belleville, and analogous effects will doubtless be obtained with similar soft rocks, though nothing can be concluded from them in reference to the effects of the blasting agents upon the hard rocks.

It is to be remarked that the addition of the salts to the gun cotton does not change the volume of gases given off by the explosion of the gun cotton; there is merely a transformation of the carbonic oxide into carbonic acid, one portion of which rests combined with the base of the salt, when nitre is used, and is replaced by an equal volume of nitrogen. The increased effect obtained for the same weight of gun cotton, must be therefore due to a greater elevation of the temperature by the deflagration.—*Comptes Rendus de l'Academie des Sciences*, 17 *January*, 1848.

For the Journal of the Franklin Institute.

On the Constitution of Glycerin and the Oily Acids.

By Prof. JAMES C. BOOTH.

When most of the fats are acted upon by alkali or acid, they are divided into an acid and a body called glycerin. When glycerin is distilled, or any fat containing glycerin, a peculiar body, acrolein, is produced.

Acrolein.—The formation of acrolein by the distillation of glycerin, the oxidation of the former to an acid resembling the acetic and other reactions, evidently point out the relation of these bodies to an alcohol; a conclusion which has been drawn by several chemists. On the other hand, when we examine the composition of four alcohols, methylic $C_2 H_4 O_2$, ethylic $C_4 H_6 O_2$, amylic $C_{10} H_{12} O_2$, cetylic $C_{32} H_{34} O_2$, all having the empirical general formula $C_n H_{n+2} O_2$, and compare this with a general formula of acrolein, $C_n H_{n-2} O_2$; or of glycerin, $C_n H_{n+2} O_6$, we observe a discrepancy which precludes us from classing either of the last with alcohol. Acrolein, as is well known, is obtained by the dry distillation of glycerin, or of any glyceric fat alone, or better by the distillation of glycerin with dry phosphoric acid. Its formula deduced from its analysis is $C_6 H_4 O_2$. By oxidation, with nitric acid, acetic and formic acids are produced by the addition of 2 eqs. water, and 4 eqs. oxygen; thus $C_6 H_4 O_2 + 2 HO + O_4 = C_6 H_6 O_8 = C_4 H_4 O_4$ (acetic) $+ C_2 H_2 O_4$ (formic.) By slower oxidation in the air, or by oxide of silver, which becomes reduced, it is converted into acrylic acid, $C_6\ H_4\ O_4$, which closely resembles acetic and formic acids both alone and in its salts. By slower oxidation in close vessels, acetic, formic, or acrylic acid, will result, while there is also formed disacrone; and Berzelius observes that if we abstract $C_2\ H$ from 2 eqs. acrolein, there remains disacrone, $C_{12}\ H_8\ O_4 - C_2\ H = C_{10}\ H_7\ O_4$; in which case the $C_2\ H$ may be oxidized into acetic, formic or acrylic acid. Acrylic acid readily passes into acetic by the assumption of water, thus $2\ (C_6\ H_4\ O_4) + 4\ H\ O = 3\ (C_4\ H_4\ O_4)$.

When acrolein is decomposed by potassa, it is first resolved into acrylate and then into acetate and formate of potassa.

We might infer from these reactions that acrolein is either a conjugate acetic acid, of which the conjugate is $C_8\ H_4$, ($C_{12}\ H_8\ O_4 = C_8\ H_4 + C_4\ H_4\ O_4$); or it is a conjugate formic aldehyde with the same conjugate $C_4\ H_2$; ($C_6\ H_4\ O_2 = C_4\ H_2 + C_2\ H_2\ O_2$). But since it exhibits no properties of an acid, the latter is the more correct inference. Moreover its behavior to nitrate of silver, strengthens this view, and its classification with aldehyde, by reason of its analogous behaviour, has already received notice from Berzelius and others. If acrolein be mingled with a solution of nitrate of silver, a white caseous precipitate appears and the odor of acrolein disappears. After some moments, especially by the aid of warmth, the precipitate blackens and acrylate of silver dissolves. Since the white precipitate cannot be a compound of acrolein and oxide of silver, the inference of Berzelius is that it is hypacrylite or acrylite of silver. The latter is most probable and confirms the analogy between acrolein and aldehyde. This acrylous acid would be $C_6\ H_4\ O_3$. The formation of disacrone and disacrone-resin by keeping acrolein and the production of acrole-resin and alkali tend to complete the analogy between aldehyde and acrolein. The rational formula for acrolein would therefore be $C_4\ H_2$, $C_2\ H_2\ O_2$, or a conjugate methaldehyde (formic aldehyde).

On this view the several decompositions and changes of acrolein are more satisfactorily explained. Like aldehyde it is readily converted by slow oxidation into acrylous acid, and by stronger oxidation into acrylic acid, which is formic acid, with the same conjugate; $C_6\ H_4\ O_4 = C_4\ H_2$, $C_2\ H_2\ O_4$. By a still stronger oxidation, the action does not stop here, but the conjugate participates in it, assuming 2 eqs. oxygen, and 2 eqs. water, so that it becomes a mixture of acetic and formic acids, a successive change which is proved by the action of potassa upon acrolein.

We are acquainted with methaldehyde in another combination, the formo-methylal. When oil of vitriol and methylic alcohol are distilled, mether, or oxide of methyl, is obtained, but when the acid is dilute and oxide of manganese is added, oxidation takes place and formomethylal results, of the composition $C_6\ H_8\ O_4$. From its behavior it is supposed to contain 2 eqs. mether, and 1 eq. hydrated oxide of formyl or methaldehyde; $C_6\ H_8\ O_4 = 2\ (C_2\ H_3\ O) + C_2\ H_2\ O_2$ (*Malaguti.*) The former, mether, is formed by the separation of water, the latter by a slight oxidation of the mether. Where the oxidation is stronger, formic mether results from the oxidation of the formic aldehyde. Moreover lignone or xylite appears to contain methaldehyde. Although we are not acquainted with the aldehyde of the formic series alone, yet we can thus trace it in combination or with a conjugate, and in the latter case we can trace it through a formous acid (acrylous) to a formic (acrylic) acid.

If we pursue the subject further we might regard acetone (mesitic alcohol) as acrylic alcohol, and the oxide of mesityl or metacetone as acrylic ether, if they be found to produce acrylic acid, as alcohol produces acetic acid. The whole series may be thus represented.

Metacetone	$C_6\ H_5\ O = C_4\ H_2, C_2\ H_3\ O.$
Acetone	$C_6\ H_6\ O_2 = C_4\ H_2, C_2\ H_3\ O, HO.$
Acrolein	$C_6\ H_4\ O_2 = C_4\ H_2, C_2\ H_2\ O_2.$
Acrylous acid	$C_6\ H_4\ O_3 = C_4\ H_2, C_2\ H\ \ O_2, HO.$
Acrylic acid	$C_6\ H_4\ O_4 = C_4\ H_2, C_2\ H\ \ O_3, HO.$

Glycerin.—The composition of glycerin is $C_6\ H_8\ O_6$, in combination with sulphuric acid $C_6\ H_7\ O_5$, in combination with the fat acids $C_6\ H_6\ O_4$ or $C_3\ H_3\ O_2$. In some it appears to be $C_3\ H_2\ O$, as in anamirtin, palmitin, and laurin. The last is assumed by Berzelius to be the real base, and called by him oxide of lipyl. Admitting it to be the anhydrous base in the fats, it appears to be hydrated in some of them $C_3\ H_2\ O, HO$, or $C_3\ H_3\ O_2$, and this hydrate in others to be doubled, $C_6\ H_6\ O_4$. The difficulty of recombining it directly with the fat acids points to a firm union of part of the water with the base, so that we may regard the separated glycerin as different from the combined base. By distillation alone, or with phosphoric acid, glycerin loses 4 eqs. water, becoming acrolein $C_6\ H_4\ O_2$, and which I have shown to be formic aldehyde with the pairling $C_4\ H_2$. When distilled with butyric and sulphuric acids, water is also abstracted, the base of fats produced, and butyrin regenerated. When glycerin is exposed with yeast and water to a temperature of 68° to 86°, it is converted into acetonic acid, of the formula $C_6\ H_6\ O_4$, so that the resulting change consists in the separation of 2 eqs. water. As it will be shown below that acetonic acid is formic acid with the conjugate $2\ C_2\ H_2$, we may infer that the base of fats contains the conjugate $C_2\ H_2$, making its rational formula $C_2\ H_2, CO$. By the assumption of 1 eq. water, by 2 eq. of the base, 1 eq. dry acetonic acid results, $2\ (C_2\ H_2,\ C\ O) + H\ O = C_6\ H_5\ O_3$. By the combustion of one half of the hydrogen in the conjugate $C_4\ H_4$, it is reduced to $C_4\ H_2$, which is the conjugate in acrolein. Whence we may infer that glycerin, by distillation, first loses 2 eqs. water, as such, leaving $C_6\ H_6\ O_4$ or $C_4\ H_4,\ C_2\ H_2\ O_4$, which last body is not formic acid although isomeric with it. By the farther action of heat, 2 eqs. of oxygen in the last body abstract 2 eqs. hydrogen from the conjugate, forming $C_4\ H_2,\ C_2\ H_2\ O_2 + 2\ H\ O$, the two former of which constitute acrolein.

Acids.—When we examine the formulas of the fat acids, we are struck with a remarkable relation between them. Butyric $C_8\ H_8\ O_4$, caproic $C_{12}\ H_{12}\ O_4$, margaric $C_{34}\ H_{34}\ O_4$, and all others, present different quantities of carbon and hydrogen, for the same quantity of oxygen, but an equal proportion of carbon and hydrogen in each acid.—If we compare the alcohols, the ethers, &c., of these bodies, we find the analogy holding good between them, as is more clearly shown in the following table, where each series is named by its acid, the acids having been most thoroughly investigated. The compounds are given in the hydrated state and their empirical general formula at the top of the columns.

	ETHERS. $C_n\ H_{n+1}\ O$	ALCOHOLS. $C_n\ H_{n+2}\ O_2$	ALDEHYDES. $C_n\ H_n\ O_2$	ACIDS. $C_n\ H_n\ O_4$	BOILING POINT.
Formic	$C_2\ H_3\ O$	$C_2\ H_4\ O_2$	$C_2\ H_2\ O_2$	$C_2\ H_2\ O_4$	212°
Acetic	$C_4\ H_5\ O$	$C_4\ H_6\ O_2$	$C_4\ H_4\ O_2$	$C_4\ H_4\ O_4$	248°
Acetonic				$C_6\ H_6\ O_4$	
Butyric			$C_8\ H_8\ O_2$	$C_8\ H_8\ O_4$	327°
Valeric	$C_{10}\ H_{11}\ O$	$C_{10}\ H_{12}\ O_2$	$C_{10}\ H_{10}\ O_2$	$C_{10}\ H_{10}\ O_4$	387°
Caproic				$C_{12}\ H_{12}\ O_4$	396°
Enanthylic			$C_{14}\ H_{14}\ O_2$	$C_{14}\ H_{14}\ O_4$	
Caprylic				$C_{16}\ H_{16}\ O_4$	
Pelargonic				$C_{18}\ H_{18}\ O_4$	
Capric				$C_{20}\ H_{20}\ O_4$	Fusible at 64°
Cocinic				$C_{22}\ H_{22}\ O_4$	95°
Lauric				$C_{24}\ H_{24}\ O_4$	113°
Myristic				$C_{28}\ H_{28}\ O_4$	120°
Benic				$C_{30}\ H_{30}\ O_4$	126°
Cetylic } Palmitic }	$C_{32}\ H_{33}\ O$	$C_{32}\ H_{34}\ O_2$	$C_{32}\ H_{32}\ O_2$	$C_{32}\ H_{32}\ O_4$	133°
Margaric				$C_{34}\ H_{34}\ O_4$	140°
Benstearic				$C_{42}\ H_{42}\ O_4$	160°

The butyric, valeric, and enanthylic aldehydes are severally known as butyral, valeral, and enanthal, but they seem to be only isomeric with those aldehydes; the formic is known only in acrolein and formomethylal. Cetylic ether is only known in composition.

When we compare the formulas of the above acids, the uniform equality in the equivalents of carbon and hydrogen is too evident to escape observation, and Dumas has endeavored to show that the radical of each acid is an exact multiple of $C_2\ H_2$. But, as Berzelius observes, he is obliged to add the equivalent of basic water to support his view, for the formula of the acid in combination with a base (dry acid), always shows 1 eq. less of hydrogen than of carbon. Thus the formula of the dry butyric acid is $C_8\ H_7\ O_3$, that of the hydrated acid $C_8\ H_8\ O_4$. Hence Dumas could not apply his theory to the combined or dry acid. If we decompose these acids by distillation alone or with lime, we obtain an acetone, and by farther action, a carbohydrogen of the composition $C_2\ H_2$, or an exact multiple of it.

A much simpler view of this series of acids, is to regard them as conjugates of formic acid. The formula of dry formic acid is $C_2\ H\ O_3$, of dry acetic acid $C_4\ H_3\ O_3$ and by subtracting the former from the latter we have the carbohydrogen; thus $C_4 H_3 O_3 - C_2 H O_3 = C_2 H_2$. Formic, taken from valeric, $C_{10} H_4 O_3 - C_2 H O_3 = C_8 H_8 = 4 C_2 H_2$; from margaric $C_{34} H_{33} O_3 - C_2 H O_3 = C_{32} H_{32} = 16 C_2 H_2$. The result is the same by abstracting hydrated formic acid from any of the other hydrated acids. From several of these acids, and from their alcohols, such carbohydrogens have been obtained, that of the acetic series being $C_4 H_4$, of the valeric $C_{10} H_{10}$, &c. When margaric acid is distilled, it appears that several margarones have been obtained of the composition $C_{33} H_{33} O$, $C_{34} H_{33} O$, $C_{46} H_{45} O$, $C_{68} H_{66} O$. Assuming it to be $C_{34} H_{33} O$, if we substract it from $C_{46} H_{45} O$, there remains $C_{12} H_{12}$. And in like manner Bussy's margarone $C_{68} H_{66} O$, or $C_{63} H_{67} O$ appears to be common margarone with $C_{34} H_{34}$. Moreover the oily body distilling at the same time with magarone is a polymeric $C_2 H_2$. That acetic acid may be regarded as formic acid with $C_2 H_2$ we may infer, although not assert positively, from its oxidation by periodic acid, whereby formic acid results. The olefiant gas derived from the acetic series, is generally regarded as $C_4 H_4$, but Berzelius considers it a peculiar radical, which he terms elayl, with the formula $C_2 H_2$; and its various combinations and metamorphoses are as easily, perhaps better, explicable on the supposition that it is $C_2 H_2$.

Another reason why we may consider the series of acids as being the formic paired with multiples of $C_2 H_2$, lies in the uniformly successive change of properties from the lowest to the highest. Formic, acetic, and acetonic are watery, butyric, and valeric oily, caproic, enanthylic, &c., smeary fats, laurostearic, &c., solid and firm. The odor and taste of formic and acetic are most pungent, of butyric to caprylic less odorous and pungent to the taste, the others inodorous and tasteless. The first four acids are miscible with water, valeric is soluble in 30 parts water at 54°, caproic to caprylic scarcely soluble, the rest insoluble. The boiling points from formic to valeric rise in nearly equal proportions. The fusing points from capric to margaric rise with nearly equal uniformity. The odor of formic and acetic are similar in character. Acetonic resembles the acetic closely in odor and in the properties of its compounds. Butyric has a mixed odor of butter and acetic acid.

It might be urged against this view that stearic acid appears to be a lower oxide of the same radical as margaric. Thus 2 eqs. margaric (dry)$= C_{68} H_{66} O_6$, and stearic $= C_{68} H_{66} O_5$. The composition of crystalized stearic acid is $C_{68} H_{68} O_7$, or $C_{68} H_{66} O_5 + 2 H O$, which water is replaced by 2 eqs of base. A simpler view is to consider it as composed of margaric and margarous acids; $C_{63} H_{66} O_5, 2 H O = C_{34} H_{33} O_3, H O + C_{34} H_{33} O_2, H O$. Hence its bibasic character. The distillation of stearic acid confirms this view, whereby margaric acid and margarone chiefly result; for 2 eqs. margarous acid $C_{68} H_{66} O_4$, $2 H O$ are resolved into 1 eq. of margaric acid and 1 eq. of margarone, while water is given off; $C_{63} H_{66} O_4, 2 H O = C_{34} H_{33} O_3 H O + C_{34} H_{33} O$ and $H O$. We ought therefore to obtain from 2 eqs. stearic acid, 3 eqs. margaric acid, and 1 eq. margarone which agrees well with Chevreul's results. We have other examples of a similar pairing of acids in the vaccinic, the dry acid $C_{20} H_{18} O_5 = C_{12} H_{11} O_3$

$+ C_8 H_7 O_2$ which are caproic and butyrous acids, and are convertible into caproic and butyric acids by simple oxidation in the air. Again, the relation of tartaric or racemic to formic acid, has been noticed by chemists, both in formula and behavior, and we may regard it as similarly constituted, except that one of the acids is anhydrous; $C_4 H_2 O_5, H O = C_2 H O_3, H O + C_2 H O_2$, which would be formic and dry formous acids. We may mention enanthic acid as the enanthylous acid known in its anhydrous state, although by its reactions it may be viewed as enanthylate of enanthal.

It may also be urged against these views, that some acids do not show their conjugate to be an exact multiple of $C_2 H_2$. Thus anamirtic acid is $C_{35} H_{35} O_4$, and palmitonic acid is $C_{31} H_{31} O_4$. But the former may consist of margaric and another acid not yet found; thus $C_{34} H_{34} O_4 + C_{36} H_{36} O_4 = 2 (C_{35} H_{35} O_4)$; and palmitonic may be half the sum of palmitic and benic acids.

The oxidation of the fat acids by nitric acid tends to confirm the views of their conjugate character. When stearic acid is heated by nitric acid it is readily converted into margaric acid by a simple oxidation of its margarous acid. By the action of nitric acid on margaric or oleic acid, the whole series of volatile fat acids, from capric down to formic, have been obtained. To obtain these acids from oleic, Redtenbacher employed fuming nitric acid, warmed and distilled the liquid; the residue contained sebacic, succinic, &c. acids. To obtain these last, Bromeis recommends a strong acid diluted with half its weight of water, so that we may infer that the oxidation is less violent in the last case, and that hydrogen would be mainly acted on, while in the former both hydrogen and carbon will be oxidized. The following table of the less volatile acids remaining shows this fact. I have added sebacic acid derived from the dry distillation of olein.

Empiric formula $C_n H_{n-2} O_8$ *Acrylic.*
Succinic $C_8 H_6 O_8 = C_4 H_2, C_4 H_4 O_8 = C_6 H_4 O_4 + C_2 H_2 O_4$
Adipic $C_{12} H_{10} O_8 = C_4 H_2, C_8 H_8 O_8 = C_6 H_4 O_4 + C_6 H_6 O_4$
Pimelic $C_{14} H_{12} O_8 = C_4 H_2, C_{10} H_{10} O_8 = C_6 H_4 O_4 + C_8 H_8 O_4$
Suberic $C_{16} H_{14} O_8 = C_4 H_2, C_{12} H_{12} O_8 = C_6 H_4 O_4 + C_{10} H_{10} O_4$
Sebacic $C_{20} H_{15} O_8 = C_4 H_2, C_{16} H_{16} O_8 = C_6 H_4 O_4 + C_{14} H_{14} O_4$
Succinic $C_8 H_6 O_8 = C_2 O_4, C_6 H_6 O_4$ Formic.
Adipic $C_{12} H_{10} O_3 = C_2 O_4, C_{10} H_{10} O_4$ Acetonic.
Pimelic $C_{14} H_{12} O_8 = C_2 O_4, C_{12} H_{12} O_4$ Butyric.
Suberic $C_{16} H_{14} O_3 = C_2 O_4, C_{14} H_{11} O_4$ Valeric.
Sebacic $C_{20} H_{18} O_3 = C_2 O_4, C_{18} H_{18} O_4$ Enanthylic.

The general formula indicates 2 eqs. less of hydrogen than of carbon, from which we may infer that by a feebler oxidation, one half of the hydrogen from the conjugate $C_4 H_4$ of the fat acids is removed, leaving $C_4 H_2$, which remains united with one of the acids, in all probability with formic acid, constituting acrylic acid. Abstracting the pairling, $C_4 H_2$, we observe by the third column that the first two and last two acids may consist severally of 2 eqs. formic, acetic, acetonic, and butyric acids. But the pimelic would leave 2 $C_5 H_5 O_4$ which obliges us to consider it as composed of formic and butyric or of acetic and acetonic. Since we have good reason for believing acrylic acid, $C_6 H_4 O_4$, to be formic acid with $C_4 H_2$, we prefer considering all the above as composed of acrylic and another of the fat acids, according to which view the fourth column is constructed. This view of the double acid constitution of the above acids sufficiently accounts for their bibasic character, 2 eqs. water being replaced by 2 eqs. base.

By examining the composition of oleic and moringic acids we find the same relation of carbon and hydrogen $C_n H_{n-2}$; for oleic $=$ $C_{36} H_{34} O_4$, and moringic $= C_{30} H_{28} O_4$. But they form monobasic acids. By subtracting acrylic acid from them we have $C_{30} H_{30}$ for the former, and $C_{24} H_{24}$ for the latter as their pairlings. Now the behavior of oleic acid refers it to the other fat acids, from which its formula must exclude it, unless we adopt the above view. Moreover the formation of sebacic acid by the distillation of olein is readily accounted for. We may then consider the oleic acids as acrylic acid with the usual copula $C_2 H_2$ or an exact multiple of it. It may hereafter be shown that other of the fat acids, besides the formic, unite with $C_4 H_2$; so that we may have a series of acrylic acids.

Before leaving this subject the views of Millon on the above acids, probably derived from those of Mitscherlich on benzoic acid, should be noticed. I have therefore placed his formulas in the lower table, to which list he adds, oleic and moringic acids. But it may be objected against his view that the basic water is wholly left out of view and is sufficient to refute his theory. How does his view explain the fact that 2 eqs. $C O_2$ neutralize 1 eq. base in an oleate?

The view above taken of the constitution of this series of acids, certainly presents the advantage of greater simplicity, which is desirable, if consistent with facts. According to the views commonly received we must adopt two radicals in the formic series, methyl $C_2 H_3$, and formyl $C_2 H$, two at least in the alcohol series, ethyl $C_4 H_5$, and acetyl $C_4 H_3$, two in the valeric series, amyl $C_{10} H_{11}$, and valeryl $C_{10} H_9$, and thus we should have in the 17 series of the above table no less than 34 radicals, and if we should add mesityl in acetone, 51 radicals.

By adopting the above views we may employ but two radicals for the whole series, methyl $C_2 H_3$, and formyl $C_2 H$. For acetyl would be formyl with the carbohydrogen, $C_2 H + C_2 H_2 = C_4 H_3$, amyl would be formyl with 4 eqs. of the carbohydrogen, $C_2 H + C_8 H_8 =$ $C_{10} H_9$, and so of the rest of the acids and aldehydes. Instead of ethyl we would have methyl with the carbohydrogen, $C_2 H_3 + C_2 H_2$ $= C_4 H_5$, instead of amyl the same with 4 eqs. of carbohydrogen, $C_2 H_3 + C_8 H_8 = C_{10} H_{11}$. In short the ether and alcohol of each series would be methylic ether and alcohol, paired with exact multiples of $C_2 H_2$. The aldehyde and acid of each series would be formic aldehyde and acid, paired with the same carbohydrogen. All the facts known in reference to the combinations and transformations of the various bodies in the above tables, as far as I have been able to obtain them, are as readily explicable on this view, as by the theories commonly adopted.

Philadelphia, March, 1848.

Description of a New Hydraulic Lifting Jack. By Mr. ALD. THORNTON.

The principle of this jack is the same as that of the hydraulic press, but not having been before applied to a lifting jack, it is thought that the present application of it will be useful for a variety of purposes. Its advantages are, the ease and steadiness with which a great weight can be raised by one person; the facility with which the lowering of the weight can be regulated without labor, and from there being no circular motion of the handle, there can be no tendency in the jack to twist from the position in which it is placed; also by the use of strong wrought-iron tubes for the cylinder and ram, the weight of the jack is less than others now known. This jack can be used in all cases where others are available, and in some where others are not so, for the motion of the lever being vertical instead of lateral, it can be used wherever there is sufficient width to place it. With a jack of the size shown one man can lift from 15 to 20 tons weight. Mr. Thornton said although the jack was not new in principle, one of its great advantages was to be found in the additional power which it gave to one man to raise so great a weight.—*Proc. Insti. Mech. Engineers.*

Civ. Eng. & Arch. Jour.

On the Fitting-up of Cylinders for Locomotive Engines, and a Description of a Machine for Boring them. By Mr. C. BEYER.

The desirableness of having all the cylinders of every class of locomotive engines perfectly alike, so that they may, at any time, be changed in case of accident, or be replaced by spare ones, it is presumed will be admitted by all; the difficulty of accomplishing this with the tools hitherto employed, will be known to most who are engaged in this branch of the business. These considerations, and the defect of cylinders, the author, from time to time, found necessary to have rectified before passing them to be used, induced him, in 1843, to direct his attention to the boring-machine.

The conditions which a good cylinder boring-machine should fulfil, may be stated as follows:—1. That it should make the cylinder perfectly round in its diameter, and parallel in the direction of its axis. 2. That the bored inside should be perfectly concentive or parallel with the outside of the barrel. 3. That the projections beyond the flanches, if there be any, should be true with the internal bore. 4. That every strain or pressure upon the barrel of the cylinder whilst boring should be avoided. The boring-machine hereafter to be described has been found, during several years' practice, to have answered these conditions.

Messrs. Sharp, Brothers & Co. cast their cylinders from wood patterns in green sand, and commence the process of fitting-up by describing or gauging off a circle upon each end of the cylinder, concentive to the barrel, and having formed this circle the ends are bevelled inwards by chipping to an angle corresponding to that of the plates of the cone mandrel. The cylinder being fastened to the mandrel is put into a two-foot slide lathe, with facing motion, and has its ends faced to a gauge, and its projections turned to a gauge, and cut to a length to gauge. There are further two notches cut out of two cone disks, so as to allow of applying an internal gauge for the out-and-out length of the cylinder. Thus prepared by turning, it is removed to the boring-machine, inserted between two plates, the faces of which are planed and the holes for receiving them bored from the boring-bar in their places; it is at once perfectly concentive with setting, and needs nothing but clamping to the plates by headed bolts or clamps by its flanches to be ready for commencing boring. For placing the tops of the steam-chests and valve facings, the turned ends are again made use of for setting, by placing upon the planing-machine table brackets placed on their faces and bored out to the same gauge; the cylinder is turned to, in order to insure the parallelism of these parts with the axis, as for similar reasons the inside of the cylinder could not be otherwise than concentive with the outside of the barrel. The author prefers making a separate set of gauges, tackling, &c. for each size of cylinders rather than economise by making one do for many, and risk the chance of mistakes; and he believes that the plan here described, to work always from the same point, is most likely to insure accuracy, as the faults made by the neglect of the workmen are not multiplied by subsequent operations.

The boring-machine bores by two cylinders at the same time, and is arranged to bore cylinders of 2′ 6″ stroke, and from 10 to 20 inches diameter. The bed is that of a common slide lathe, sufficiently long to carry a double set of driving gear, and admits of a sufficient traverse of the boring-carriage. The boring-bar is supported by three bearings, the former of which is stationary and firmly fastened to the bed to resist the end and pressure of the cub when boring; the latter are fixed upon the carriage and travel with it along the boring-bar, and serve for securing the cylinder during boring, as will be shown hereafter. To cause the boring-carriage to move endways, a train of wheels descends at the back of the machine to give motion to the shaft, and is transferred by means of a feathered worm to the worm-wheel and pinion, both of which move loose above the fast stud of the carriage. This same stud serves as a fulcrum for the lever, carrying upon opposite projections the intermediate pinions, which gear into the stud pinions. It will be clear, therefore, that by setting the lever in such a position as to bring one pinion into gear with another pinion fast on the rack-pinion shaft, motion will be given to the boring carriage in one direction; and in an opposite or contrary direction by moving the lever so as to bring the pinions to gear with each other; and this carriage will be stationary or independent of the driving gear altogether, by keeping the lever in its middle position. The rack pinion shaft is extended towards the front of the machine, to work the carriage by hand when putting in or taking out the cylinder. A provision is also made in the train of wheels for varying the traverse of the carriage by changing the pinion.

To hold the cylinder while boring, the top of the carriage is formed into a kind of square frame, by means of two plates, planed on the inside and fastened to the sides of the bearings or standards and two cross stretchers. These latter are also placed upon their inner faces and are secured to the sides and top of the boring-carriage, and have holes bored in them when secured in their places, by means of the boring head upon the bar corresponding in diameter to the turned projecting ends of the cylinder to be bored. It will be seen, therefore, that if the figure of the cylinder to be bored be turned to the same gauges as the holes are bored to, it needs only inserting and clamping fast by the T bolts to be ready for boring without requiring any setting in its pan whatever. One of the cross stretchers is a fixture, whilst the other is removed every time a new cylinder is to be fixed. The boring head is a fixture upon the bar, and has only one plain square tire for boring, ground to cut either way. This tool fits into a planed recess made slightly dovetailed, and is held fast by a set screw, and easily adjustable to any diameter by another of these machines. We employ three of these machines—two double ones, and a single one, and one man attends to these and the lathe for facing and turning the ends of the rough castings of the cylinders. The cylinders are cast as hard as we are able to cut them with the best cutting tools we can make, and we find it more advisable to complete the boring in three cuts; the first is often as much as ¾ inch in depth, the second we leave about ⅛ inch, and the third can hardly be called cutting, but is merely clearing up or finishing. The advance, or traverse, we rarely change, and is set to ¼ of an inch for each revolution of the boring-bar; or is, for quickest speed of the bar, 3 revolutions per minute; in the second, 1·8 revolution per minute; in the third, or lowest speed, 1·2 revolution per minute. For boring 15 inch cylinders—for roughing out, 1·8 revolution per minute, or cut at 7 feet per minute; for boring 3 revolutions per minute, or cut at 11·78 feet per minute; and for finishing, 1·2 revolution per minute, or cut at 5·65 feet per minute. Ibid.

Description of a Perforating Machine, made for Mr. Evans, the contractor for the iron tubular bridge which is to carry the Chester, and Holyhead Railway over the river Conway. By Mr. FOTHERGILL.

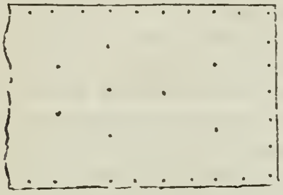
This machine is employed to perforate the plates for the abovenamed bridge, and is at present adapted to punch such pitches only as that work requires, viz., 3 inches and 4 inches from centre to centre of rivet holes, with latitude for departing considerably from those (general) pitches in the lateral rows of the holes. This machine is constructed to perforate, at each stroke, a row of holes across a plate 3 ft. 5 in. broad; but, by employing a series of card plates (similar to the cards used in the Jacquard loom), any number of punches may be put out of action at pleasure; and by means of a blank card at the end of the series, the machine is put out of action at a point where no obstacle is presented to the taking out of the perforated plate and putting a blank plate in its stead. The operation of changing plates, weighing six or seven hundredweight each, is performed by half a dozen men in less than one minute, and whilst one plate is being punched, these men get another ready to put into the machine. As these machines take eleven to twelve strokes per minute, it follows that (with a 4-inch pitch) a 12 feet plate may be punched in less than four minutes, and consequently that (allowing one minute for changing) it may perforate twelve such plates per hour. Many of the plates in the bridge are 12 feet long, 2 ft. 8 in. broad, and ¾ inch thick, and are punched for rivets 1 inch in diameter. As there are but few engineering concerns where such a perforating machine as that at Conway could be employed more than an hour or two per day, it appears to be very desirable that ironmasters should have them, and that they should also have machines for straightening and bending plates; by which means they would be enabled to supply their customers with plates in a fit state for being riveted together. Were this system brought into practice, engineers would turn their attention to adapt their work to the capabilities of the perforating machine, and thus great perfection, despatch, and economy of construction would be the result. A drawing represented a machine (similar in principle to that already described) adapted to perforating paper and thin sheet metal, such as sieves and window-blinds are made of, in which plain perforations, arranged in squares, may be made by a single row of punches; and perforations arranged quincuncially, may also be made by a single row of punches, by giving to the plate a lateral alternating motion; but a double row of punches, arranged intermediately to each other, is preferable. Each of these arrangements admits of a great variety of fancy patterns by the application of the Jacquard principles. A large class of patterns may be produced by punches of various forms and sizes, which shall be so grouped together as to give to the work a columnar effect; and the range of this class may be extended by giving the plate a zig-zag or waved motion, and still further extended by combining it with the Jacquard. Another class of patterns may be produced by employing two distinct sets of punches of different size or form, and with each set a Jacquard, to bring punches of the one or other set into action as required, and thus be made to produce representations of figures, landscapes, &c., at pleasure. A further variety of patterns might be produced by the introduction at intervals of punches containing set patterns, such as sprigs, flowers, &c., and perforating the ground with small punches.

The foregoing is but a brief description of the capabilities of the Jacquard Perforating Machine, which in good hands would be found to be nearly co-extensive with those of the Jacquard loom. Another drawing represented a double-acting machine for shearing (at the one side) and punching (on the other) at the same time, plates of iron ¾ inch in thickness with holes 1½ in. in diameter, and to perform both processes to the extent of 18 inches from the edge of the plate.

In order to give an idea of the nature of the work to be performed by this machine, we subjoin the annexed diagram and description, taken from the *Manchester Guardian:*—

"The diagram represents a portion of a wrought-iron plate, which we will assume to be, when entire, 12 feet long by 2 feet wide, and

¾ inch in thickness, and requiring to be perforated, along each side and end by a row of holes *exactly* four inches asunder from centre to centre, and each an inch in diameter; as well as by certain intermediate holes of the same size, the situation of which will be best understood from the diagrams.



"On looking to the left hand of the diagram representing the entire end of the plate, it will be seen that there is vertically a row of seven dots, representing seven perforations or rivet-holes. These perforations the machine makes at one moment, by bringing down with immense force seven punches of tempered steel, upon that part of the plate which at the time rests upon the same number of dies, also of tempered steel. These perforations being made, the punches are lifted clear of the plate, which is then moved forward longitudinally, exactly four inches; and then the striking peculiarity of the machine comes into play.

"It will be seen on looking carefully at the diagram, that the second row vertically of perforations, counting from left to right, instead of seven contains only two, one at the upper and the other at the lower margin, each forming a part of the two side rows of rivet-holes. These two holes the machine perforates also at one blow; but as there are seven punches, and only two are required, the five intermediate ones are thrown out of use by a contrivance exactly similar in principle to that of the Jacquard loom, by which figures are produced in silks and other fabrics. The third vertical row of holes, still continuing from the left, consists of four, the fourth again of two, the fifth of three, and so on, the number varying through the whole length of the plate; and, in each case, the machine itself, without the slightest interference of the workman, moves the plate on to the required distance, selects the proper number and right situation of the punches, makes the requisite number of perforations, and throws itself out of action when the plate is completed. Those who are aware of the force necessary to perforate an iron plate of moderate thickness, even with a single punch of small size, may form some judgment of the enormous power required to impel seven punches, each an inch in diameter, through plates three-quarters of an inch thick; and it is a little singular to see this enormous power regulated in its operation by the identical means employed in producing figures in the most delicate fabrics. The machine is calculated to make, when necessary *twelve* perforations by one stroke, and to produce any requisite combination of twelve or any smaller number of punches, at distances of three or four inches from each other. The speed with which the work is performed may be understood from the fact, that it regularly completes the perforation of one plate of the size above described,—namely, 12 feet long and 2 ft. 4 in. wide,—in four minutes; and if the plates were so quickly supplied as to prevent any loss of time, which might easily be done, it would complete them regularly at that rate. As it is, fifty have been completed in four hours. But the facility and dispatch resulting from the use of the machine are not, perhaps, its greatest merits, so far at least as the construction of tubular bridges and beams are concerned. In such cases, the strength of the fabric depends in a great degree upon the whole of the rivets completely filling the perforations, retaining a regular cylindrical form, continuing perfectly straight, and being, throughout their length, exactly at right angles with the faces of the plates. As each of the perforations represented in the diagram is intended to correspond with a similar perforation, either in another plate, or in an angle or T iron, it must be obvious that deviations in opposite directions of a sixteenth of an inch in each, would prevent them fitting each other by an eight of an inch altogether; and, whatever might be done by enlarging one or both of the holes, to bring them a little nearer each other, the firmness and strength of the work must be impaired by the direction of the rivet being rendered in some degree oblique, instead of being exactly at right angles with the plate; whilst, in the work performed by the machine, the perforations are set out with such accuracy that they always correspond precisely, and the rivets retain their proper form and direction."

Ibid.

Description of a Glass-Blowing Apparatus, being a new invention in the Blowing of Glass. By MR. WM. COOPER.

This invention consists in effecting the blowing of glass by means of double bellows placed under the floor, acted on by the foot of the glass-blower, and the air is carried to the blow-tube by means of a flexible tube, easily attached and detached from the nozzle of the ordinary iron tube. The advantages are stated to be, that larger articles can be blown, that the glass is freer from "cockle," and that the lungs of the workman are saved, and his muscular energies not being so severely taxed, he will be able to produce a great deal more manufactured goods in a given time. The air blown by the bellows being of a much purer quality than that from the lungs, produces a better article. That larger sizes and a thicker substance of blown plate may be obtained by this new process, and the sheet-glass manufacturer will be able to compete with the cast plate-glass monopolist. That "carboys" to contain twelve and sixteen gallons have been successfully blown by this process. Mr. Cooper then recommended that this process should be adopted in Edinburgh and Leith, where coal is cheaper than in Staffordshire by 4*s.* per ton, and where living and house-rent are about one-fourth less; the workmen all preferring Leith, from its healthy situation, cheapness, and family conveniences. Locality, he stated, is now looked at; economy in carriage is itself a profit to the manufacturer, now that the duties are removed, and all the English manufacturers circumscribing their connexion.

Proc. Roy. Scottish Soc. Arts.—Ibid.

Accident from the Bursting of a Boiler at Manchester, causing the Loss of Life.

Our Manchester correspondent, writing yesterday afternoon, informs us of a dreadful accident, which has occurred in that town, from the bursting of a boiler at the manufactory of Mr. Thomas Riley, spindle and flymaker, Medlock-street, Ardwick. The catastrophe occurred about half-past eight o'clock yesterday morning, and eight human beings, varying from 20 to 30 years of age, were sent to their last account, without a moment's warning. Five of the unfortunates were workpeople, in the employ of Riley, the owner of the boiler. Two children, belonged to a butcher, named Wardsworth, resident in the neighbourhood; and another was the child of a blacksmith, whose forge was in the same yard as Riley's manufactory, and which was also completely destroyed. There were others seriously hurt, and they lie at the Manchester Infirmary in a dangerous state. It was currently reported in the neighbourhood of the accident, that the boiler has been considered in a dangerous condition for some time past, and that people have refused to work at the manufactory in consequence. It was, therefore, thought proper to take Riley into custody. Another thing which tells against him is, that the person whom he employed to take charge of the engine, was a boy, only 15 years of age. This boy's name was Joseph Atkinson, and he was killed. The accident has, of course, caused great excitement in Manchester, and the inquest, which will, doubtless, be held this day (Saturday), is looked forward to with great anxiety. Min. Jour.

The late Fatal Boiler Explosion at Manchester—Verdict of Manslaughter against the Owner.—The inquest arising out of the fatal boiler explosion at Manchester on Friday last, was adjourned from Saturday to Wednesday afternoon. There were nine dead when the jury was summoned on Saturday, but since that time three others have been added to the victims already mentioned. The evidence adduced was of a very voluminous character, and tended to show that the boiler was unsafe; and that Mr. Riley, the owner, had been frequently warned of that fact. After hearing all the evidence, the jury unanimously returned a verdict of "manslaughter" against Mr. Riley. Ibid.

Experiments on the Strength of Materials. By GEO. RENNIE, ESQ.

In consequence of the numerous accidents that are daily occurring through the failure of structures on the lines of railway which now intersect the country in all directions, every experiment or remark however trivial, respecting the strength of materials, must be looked upon by the practical engineer as subjects of the greatest importance; and the more especially so, when such remarks are made by men, who have long been advantageously known to the world for their skill and dexterity in the performance of experiments of this sort, as well as for the accuracy and attention with which their results have been registered and applied to practice. Amongst the list of individuals here alluded to, George Rennie, Esq., holds a distinguished place: he took the lead of the experimentalists in this country and his results have always been received with the greatest confidence in important erections, not only for the skilful selection of the forms and specimens which he has employed, but also for the great care and attention with which the results were obtained and accommodated to practical purposes.

Since the singular and unexpected failure of one of the large girders in the Dee Bridge, on the Chester and Holyhead Railway, a great many useful and interesting experiments have been made, and numerous inferences have been drawn for the purpose of determining the strongest form of girder for railway bridges, and numerous papers have been published in the journals, drawn up by men, who with consummate scientific knowledge, combine the most extensive practical experience; and the result has been, that forms have been elicited, differing very considerably from those which had previously been considered as the best; and it is to be hoped, that by continuing the experiments with the some degree of ardour, the best of all possible forms will ultimately be detected, which will doubtless be the means of preventing so many frightful and fatal accidents as have lately been recorded in the public prints.

Amongst the publications that have lately issued from the press, containing much useful information on subjects of this nature, is an Architect's Pocket Book for 1848, by Messrs. John Williams & Co. of the Strand, London, in which are recorded a series of experiments performed by the eminent individual above named, so far back as 1817, and subsequently, but have never before been published; and since the subject is one of such very great importance in a practical point of view, we avail ourselves of the publishers' permission, to transfer the following material portions of the series to our pages.

Taking the Series as registered by the experimentalist, we have Series No. 1, on the Transverse Strength of Wooden Beams resting on rollers, 3 feet 9 inches apart.

Species of timber.	Sectional dimens.	Breaking Weight	Species of timber.	Sectional dimens.	Breaking Weight.
	in in.	lbs.		in. in.	lbs.
English Oak .	2×2	1369	English Oak .	1+1	160
Ditto . .	"	1456	Ditto .	"	168
African Oak .	"	1425	Ditto .	"	193
Ditto . .	"	1447	African Oak .	"	202
Ditto . .	"	1873	Ditto .	"	224
Ditto . .	"	1968	Ditto .	"	224
Yellow Dantzig Fir	"	999	Yellow Dantzig Fir	"	118

Series No. 2.—On the Tensile Strength of various Timbers per Square Inch.

	lbs.		lbs.
Ash .	12,000	White Deal .	10,000
Beech . .	10,500	American Oak	12,200
Elm . .	10,000	English Oak .	12,000 to 10,500
Yellow Fir .	9,600	Riga Oak .	12,000
		African Oak .	14,000 to 15,000

Series No. 3.—On the Tensile Strength of different kinds of Metals one quarter of an inch square.

	Tensile force in lbs.	Force in tons pr. square inch
Cast iron, horizontal	1166	8.0*
Cast iron, vertical	1218	
Cast steel, tilted	8391	59.94
Blister steel, reduced per hammer	8322	59.44
Shear do. do.	7977	52.50
Swedish iron, do.	4504	32.17
English do. do.	3492	24.94
Brass-hard gun metal, two trials	2273	16.23
Wrought Copper, reduced per hammer	2112	15.08
Cast Copper	1192	8.06
Fine yellow brass	1123	8 00
Cast tin	296	1.60
Cast lead	114	0.81

Series No. 4.—On the Transverse Strength of Cast Iron Beams, for the purpose of determining the effect of Wrought Iron, when mixed with Cold Blast Blaenarvon Cast Iron in different proportions.

No. 1. Quality of iron, No. 1, Blaenarvon (unmixed with wrought iron,) 4 feet 6 inches between supports, and 1 inch square.

Three bars experimented upon, the average weight of each being 16lbs. 5 oz.

Average deflection with 506 lbs. in scale=1.76 inches, and breaking weight, 511 lbs.

No. 2. Three bars of similar dimensions to the above, mixed with 10 per cent. of wrought iron, and weighing, upon an average, 16 lbs. 9 oz.

With a weight of 511 lbs. deflected 1.50 inches, and broke with a weight of 625 lbs.

No. 3. Three bars of similar dimensions to the above, mixed with 20 per cent. of wrought iron, and weighing, upon an average, 16 lbs. 10 oz. each.

With 628 lbs. in the scale, deflected 1.58 inches, and broke with a weight of 726 lbs.

The results are, that 10 per cent. wrought iron, with No. 1 *Blaenarvon* Cast Iron, gives an additional strength of 22½ per cent., and with 20 per cent. wrought iron, an additional strength of 31½ per cent.

Similar Experiments were made with bars of Blaenarvon Cast Iron, mixed with 30, 40, *and* 50 *per cent. of Wrought Iron respectively—the results of which were:*

For 30 per cent. of wrought iron, an increase in the strength of the bar	60 per cent.
For 40 per cent. of wrought iron, an increase of	33 "
And for 50	26½ "

* These were unusually strong specimens, but the average of subsequent Experiments on various irons does not give more than 6½ tons per square inch.

From which it appears, that 30 per cent. of wrought iron, mixed with Blaenarvon, gives the greatest strength.

Series No. 5.—On the Comparative Strength of similar bars of Blaenarvon Cold Blast Iron in different positions, 1 inch square.

No. 1.—In the form of an arch, 4 feet 6 inches between the abutments; rise or versed sine $\frac{1}{15}$ of chord or span, bore 1267lbs.

No. 2.—A bar similar in every respect, but the arch inverted bore 357lbs. and was therefore $3\frac{1}{2}$ times weaker than the former arched beam.

No. 3.—The same with versed sine $\frac{1}{8}$ of chord or span, bore for the mean of 2 experiments—from whence it appears that the bar in this last position was 3.6 times stronger than the straight bar, and 5 times stronger than the bar in the form of an inverted arch of $\frac{1}{15}$ rise 1729lbs.

No. 4.—Same as above, but reversed 280lbs.

Series No. 6.—On the Transverse Strength of Bars of Blaenarvon Iron, Nos. of different Depths and Thickness, but of equal Weight with Bars of 1 inch square, or from 16 lbs. to 17 lbs. each.

	Distance between supports. ft.	in.	Weight of Bar.	Depth. inch.	Thickness. inch.	Breaking Weight. lbs.
Rectangular	4	6	$16\frac{1}{2}$	2	$\frac{1}{2}$	1121
Do.	4	6	$16\frac{9}{10}$	3	$\frac{1}{3}$	1568
Do.	4	6	17	4	$\frac{1}{4}$	2352
Upper side Parabolic	4	6	11	2	$\frac{1}{2}$	953
Do. Parabolical Semi-elliptical	4	6	11	3	$\frac{1}{3}$	1429
Do. Semi-Elliptical	4	6	12	2	$\frac{1}{2}$	950
	4	6	12	3	$\frac{1}{3}$	1440

N. B.—The force required to crush a cubic inch of Cast Iron is 70 tons. The permanent deflexion varies from $\frac{1}{3}$ to $\frac{1}{2}$ of the breaking weight.

In addition to these experiments, we take the liberty of transcribing the following Practical Solution of Problems, for calculating the Strength of Materials, the experimental data for which will be found under the words Tension, or Pressure, in the Table of Specific Gravities, published in the Pocket Book.

Direct Cohesion.

What weight will be required to tear asunder a piece of oak timber, the scantling of which is $4'' \times 4''$?

Suppose 11,000 for tensile strength in lbs. for English oak; in this scantling we have $4'' \times 4'' = 16''$; therefore—

$11{,}000 \times 16 = 176{,}000$ for utmost tensile strength; in practice one-fourth of this is taken:

$$\frac{176{,}000}{4} = 44{,}000.$$

The weight being given, and the area of section required, divide the weight by the tabular number; as required the scantling of fir for supporting a hanging weight of 30,000, multiplying by 4 we have 120,000 and the tabular number of fir is 9,000; by which divide, and we get 13″·33 for sectional area, and the square root of this is the side of the fir scantling required ;=3″·65.

Transverse Strength.

Required the weight a beam of red pine, of 9″ × 22″ scantling and 25 ft. long would bear, applied in the middle of the beam; multiplied continuously the "Constant of Strength" by 4, by depth, by sectional area, all in inches, and divide by the length of bearing in inches, or in this case—

$$\frac{1341 \times 4 \times 12 \times 108}{300} = 69517, \text{ and } \tfrac{1}{4} \text{ of this, or } 17379,$$

would be the weight applied in practice; and if the weight is to be distributed over the beam, it will bear double the weight.

The weight, the bearing, or distance between the points of support, and depth of the timber being given, required the width it will then be; as weight 20 tons, length of bearing 20 ft. (or 1 ton per foot), depth of oak timber 20 ft.—

20 tons = 44,800 lbs.
20 feet = 240 in.

and constant for oak 1180; then we have

$$\frac{44800 \times 240 \times 4}{1180 \times 4 \times 20 \times 20} = 20''.66, \text{ one half of which}$$

would be sufficient, if the weight is to be equally distributed throughout.

It is not unusual to consider the strength of oak as equal to one-fourth of that of cast iron, and that of yellow fir as 0·3 of cast iron.

With regard to cast iron girders, the area in feet of the floor is multiplied by 240, and the product in pounds is considered the weight to be provided for; the area of the bottom flange is made equal to half the sectional area of the whole beam; the area of the top flange to be equal to one-sixth of the bottom flange; the remainder will give the area of the web between the flanges. Supposing the bottom flange to be 18″ × 2″ = 36″ the top flange would be 6″ in area; 36″ × 2″ = 72″ = sectional area of beam, and 72″—42″ = 30″ for area of web between the flanges. London Artizan.

Calorific Action of an Electric Current. (Extract from a letter from M. Plücker to M. Arago.)

Translated for the Journal of the Franklin Institute.

"An air-thermometer placed between the two poles of a strong magnet rises exactly as though the temperature had augmented. *The air is dilated by magnetism as it is by heat.* In order that the experiment may succeed well, the poles of the magnet must be fixed as closely as possible together, and the reservoir of the thermometer must have a form corresponding to that of the poles of the magnet, taking care that it cannot be compressed by these poles when they become magnetic. The temperature of my air-thermometer having become constant, I closed it by a small drop of alcohol in a glass tube of 1 mm. bore (·04 inch). When the magnetism was excited by a Grove's battery of 12 elements, the drop of alcohol was seen to be repelled outwards about 3 mm. (·12 in.) and to return even more rapidly to its former position upon the interruption of the current."

Comptes Rendus de l'Acad. des Sciences, Feb. 7th, 1848, p. 237.

Experiment with the Electric Telegraph.

Translated for the Journal of the Franklin Institute.

M. Dujardin of Lille, communicated to the Academy, the result of an experiment upon Electric telegraphing which he performed between Lille and Amièns, on the 25th January last. The telegraph was worked without a battery, by means of a magneto-electrical machine with vibrating armature, composed of three magnets. The experiment succeeded completely. During the course of the experiments, which lasted an hour and a half, but one of the magnets was employed, the whole power of the machine having been found much too great. Ibid. 14th Feb., p. 239.

On the Colored Photographic Image of the Solar Spectrum. By M. Edmond Becquerel.

The author in the course of his researches upon the chemical action of light was led to this remarkable fact, that the solar spectrum could form its image with colors corresponding to its own, upon a plate of silver properly prepared. For this purpose the plate may be attacked by free chlorine with the precautions indicated in the note presented to the Academy: the sensitive coating which is formed upon the surface of the plate, is red in the prismatic red, yellow in the yellow, green in the green, blue in the blue, and violet in the violet. The reddish tint turns to purple in the extreme red, and extends even beyond Fraünhofer's line A; as to the violet it continues far beyond A, gradually becoming more feeble. When the action of the spectrum is permitted to last a long time, the tints become dark, and the image finally takes the metallic lustre; the colors have then disappeared.

According to the preparation of the plate and the thickness of the sensitive coating, any one of the tints of the spectrum may be made to predominate; thus a surface well prepared and previously in diffused light colored purple under a deep red glass, gives a beautiful colored photographic image of the spectrum, in which the orange, yellow, the green, and the blue, are marked with the greatness clearness. The substance formed upon the surface of the silver is not the white chloride but probably a sub-chloride, since it is not strongly colored beyond the visible violet, as the chemically precipitated chloride is, and the maximum of action is found in the yellow, where the maximum of luminous intensity is, or moves towards the red, according to the preparation to the plate. To get a tolerably rapid action, it is necessary to use a strongly concentrated spectrum. These effects explain the red color of the chloride of silver, and of the sensitive paper formed with that compound, in the red rays, which has been already observed by MM. Seebeck and Herschel.

The author has succeeded in preparing by means of free chlorine, and also by using bichloride of copper, a sensitive coating of the chloride of silver so impressed that now only certain parts of the spectrum are represented with their colors, but besides, white light makes a white impression.

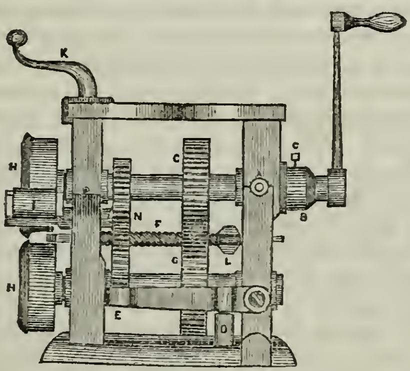
The compound formed upon the surface of the silver, by the action of chlorine, is the only one hitherto found which shows the properties here mentioned. Up to the present time, it appears necessary to keep the colored prismatic image in the dark, and the author has not found the means of fixing it under the influence of light. If the fixation could be accomplished, and if the sensitiveness of the material was greater, we could not only draw but also paint by light; nevertheless the results mentioned show that the solution of the problem is possible. Ibid, 7th Feb., 1848, p. 181.

New Liquid for Lamps.

In a letter from M. Louyet, of Brussels, read to the Academy of Sciences of Paris, by M. Pelouze, he states that he has satisfied himself by experiment that the essential oil obtained by the distillation of common resin, when burned in the camphene lamp equals if it does not surpass the camphene itself. He does not say whether in light or in smoke. But the fact reminds us of similar experiments made in this city some years ago by one of our most distinguished chemists for the purpose of ascertaining whether certain products obtained by the distillation of gas tar could not be substituted for camphene. It was found that the substance burned beautifully, the only drawback being. that nobody could stay in the room with it owing to the smell. M. Louyet attributes the invention of the lamp for burning camphene to the English under the name of the Vesta Lamp. The Vesta Lamp was nothing more than the ordinary camphene lamp which had been used and patented in this country years before.

Description of an improved Wiring Machine for the manufacture of Tin, Sheet-Iron, and other Plate Ware, Patented by A. W. Whitney, Woodstock, Vermont, 1847.

The face plates or rolls H H, are made of cast-steel of an improved form having the journal boxes of their shafts in a cast-iron frame. This frame consists of two pieces, fitted together at A, and at the top of the upright piece under K. The journal box A has two projecting ears or bearings, (one of which is seen at A,) at right angles to the shaft B H, on which ears it is supported, forming a fulcrum to the shaft BH; thus preserving the bearing of the shaft A perfect, while the end H is raised and depressed in the process of working. B is a movable collar for adjusting the shaft and rolls longitudinally, with great nicety. C is a binding screw, for keeping the collar in place. In the shaft concealed by the collar B, is a spiral groove, into which the binding screw enters. Thus, by turning the collar on the shaft, a nice longitudinal adjustment can readily be obtained. The movement of the rolls H H, is secured in the usual manner by the connecting gearing G G. F is a gauge extending between the rolls, with a spring F, and a thumb nut L, for adjustment. I is a forming gauge, consisting of a friction roll, attached to the side of a short rod or shaft, and having its journal bearing in the frame. On the inner end of this shaft is a ratchet wheel N, for placing the gauge in any desired position. Fitted to the ratchet is a latch E for holding it in place. At D is a spring, pressing the latch into the teeth of the ratchet.



In the working of the machine, the bearing at A always remains perfect; for its journal box, by turning on its ears, accommodates itself to the shaft in all positions. Again, the inclination of the shaft B H is always towards H, so as to bring the collar B in contact with the box. Now, to compensate for any wear which may displace the rolls H H, as well as to adjust them to different kinds of work, the collar B is always immediately adequate.

It will readily be seen that the above improvements secure advantages, not possessed by any former construction, rendering the machine susceptible of immediate adaptation to plates of different thickness.

The above improvements are applied to other machines.

On the Curiosities of Glass Manufacture. *By* Mr. A. Pellatt.

This communication would have been made on the Friday before, but for an alarm of fire in the Theatre of the Institution. On the present evening, as it was not considered prudent to re-erect the furnace which had caused the apprehension, Mr. Pellatt explained the various processes by diagrams, models, and working instruments. Of these processes we can give but a brief outline. It was noticed that in ancient, as in modern glass, sand was the base, and alkali the solvent, and the injury occasioned to the glass by an excess of the latter ingredient was pointed out. That opacity of glass, called *devitrification* was explained as consisting in the formation of a multitude of minute crystals in close contact with each other on the surface of the glass. The process of annealing was then described; and it was shown that a glass tube forty inches in length contracts if annealed, a quarter of an inch, while an unannealed tube of the same length contracts but one eighth of an inch. The most interesting part of Mr. Pellatt's discourse referred to the mode of making *Vitro di Trino*, and of impressing heraldic devices, &c., on glass. In the case of Vitro di Trino, the gathered glass, after being expanded into a bulb or cylinder of the required size, has rods of other glass or enamel attached to it in a vertical position, at equal distances all round, and then, the bottom being held, the top part is more or less turned, so as to give an equally inclined twist to the vessel and the rods. A similar but larger vessel is made, but which is also turned inside out, and then the former is put into the lathe; and, being expanded by blowing, the two come together and adhere by the rods and their intersections, but enclose small portions of air, which, being regular in size, form and disposition, give the character of the glass. When heraldic devices, &c., are to be impressed, a mould of the design is made in a fit earthy material, (being puzzolana or one of the volcanic deposits,) and this is placed within, and forms part of the larger iron mould in which the decanter is blown—when the large mould is removed, the earthen portion still adheres to the glass, and continues in its place until the bottle is finished. After the annealing, the mould is moistened with water, and immediately separates, and the impression is found really perfect.

At the close of Mr. Pellatt's communication, Mr. Faraday called the attention of the members to two circumstances of philosophical interest, which had happened during the momentary apprehension of fire to which we have alluded.—1. At three different times the water poured on the cinders of the temporary furnace, when, on the fire being drawn, they fell on the hearth, became decomposed by the ignited carbon; and the hydrogen, driven by the sudden expansion of steam, &c., having penetrated the hot and porous hearth stone, found its way to the heated beams and space which were immediately beneath.—2. This gas, though not in the state of flame as it passed through the hearth-stone and pugging, was, after being mixed with the air below, sufficiently hot to enter into combustion,—producing three gushes of flame downwards from beneath the hearth:—and it was experimentally shown that a temperature so low as barely to scorch paper, and in which the hand may be held for some seconds without inconvenience, is yet able to ignite a jet of coal or hydrogen gas in air.—*Proc. Roy. Inst.* Athenæum.

Origin of the Plague.

In ancient Egypt the plague was unknown. Although densely populated, the health of the inhabitants was preserved by strict attention to sanitary regulations. But with time came on change—and that change was in man. The serene climate, the enriching river, the fruitful soil remained; but when the experience of 2000 years was set at nought,—when the precautions previously adopted for preserving the soil from accumulated impurities were neglected,—when the sepulchral rites of civilized Egypt were exchanged for the modern but barbarous practices of interment,—when the land of mummies became, as it now is, one vast charnel-house—the seed which was sown brought forth its bitter fruit, and from dangerous innovations came the most deadly pestilence. The plague first appeared in Egypt in the year 542, two hundred years after the change had been made from the ancient to the modern mode of sepulture; and every one at all acquainted with the actual condition of Egypt, will at once recognize in the soil, more than sufficient to account for the dreadful malady which constantly afflicts the people.—*Mr. Walker on the Metropolitan Grave Yards.* Ibid.

On the Electro-Bronzing of Metals.

MM. Brunel, Bessin, and Gaugin presented to the *Academie des Sciences,* at Paris, specimens of metals bronzed by electro chemical means. M. de Ruolz, in 1841, communicated to the academy a process for bronzing metals, by depositing upon them, by the aid of the galvanic battery, layers, more or less thick, of brass or of bronze. This process, which required the employment of the double alkaline cyanides of copper and zinc, or of copper and tin, was not adopted in practice, on account of the great expense of the cyanides, and for other reasons. MM. Brunel, Bessin, and Gaugin, have substituted for the cyanides, a solution in water, of 500 parts of carbonate of potash; 23 chloride of copper; 40 sulphate of zinc; and 250 nitrate of ammonia. To produce bronze, a salt of tin is substituted for the sulphate of zinc. By means of these solutions of brass or of bronze, a coating can be given to cast or wrought-iron, steel, lead, zinc, tin, and alloys of these metals, with one another, or with bismuth and antimony, after a previous cleaning according to the nature of the metal. The operation is conducted with a cold solution. The metal to be coated is placed in connexion with the negative pole of a Bunsen battery, a plate of brass or of bronze being employed at the positive pole. When the objects have been covered with a coating of the metal desired, and have received their proper color, they will be found to rival the finest bronze. Civ. Eng. & Arc. Jour.

Sulphate of Iron for Purifying Gas.

M. Marens, of the University of Louvain, has made a discovery in the use of sulphate of iron for the purification of coal gas. By this arrangement, the gas passes through two purifiers: in the first is placed 1 cwt. of sulphate of iron, dissolved in 83 gallons of water, and in the second milk of lime, made by adding 83 gallons of lime to

375 gallons of water. On passing from the second purifier, the gas is almost completely deprived of its sulphuretted hydrogen, that it scarcely changes the color of paper moistened with a solution of oxalate of lead. By this process, there is a greater deposit of tar in the solution than when water alone is employed; and there is a much more abundant condensation of aqueous and ammoniacal vapors—so that during long-continued frosts, the pipes have been kept entirely free from ice, which causes considerable trouble and expense. The cause of tar depositing in a ferruginous solution more readily than in water, arises from the sulphate of iron having a greater affinity for the tar, which it condenses, and carries down with it; and the greater condensation of vapors contained in the gas is caused by a more complete absorption of ammonia, which always has a tendency to mix with other vapors. The above quantity of sulphate of iron is sufficient for purifying the gas from 25 to 27 tons of coal; the solution is then so impregnated to saturation, as to require changing. It is probable the residue of this plan may become a valuable article of commerce.

Ibid.

New Method of Treating the Ore of Platinum.

Instead of the tedious operation of obtaining pure platinum from the ore, employing 8 or 10 parts of acid to one of platinum, M. Hess suggests the following as an improvement:—Melt one part of platinum ore with two or three of zinc, which will form an alloy very friable, and easily reduced to a fine powder. This powder is then to be sifted, and on it poured dilute sulphuric acid at the common temperature of the atmosphere. The temperature is then gradually raised, and the metals allowed to macerate as long as there is anything to dissolve; the acid in a short time separates all the zinc from the alloy, and the principal part of the iron contained in the ore. A solution is obtained in which hydrosulphuric acid produces no precipitate. Having poured off the liquid, the residue is a fine powder, which, having been well washed, is treated with nitric acid, which dissolves the copper, and other foreign metals; the platinum is then dissolved in nitrochloric acid, and then proceeded with in the usual way. **Ibid.**

Friction Hammer.

A novel machine, just completed, is now at work at the Great Western Works, at Bristol, the invention of Mr. John Jones, manager of the works, who also invented the "Cambrian Engine." The machine is called a "Friction Hammer," and consists of frames of cast-iron, in which are vertical slides acting as guides to the hammer, and also supporting the machinery necessary for putting the hammer in motion. The hammer consists of a plain bar of flat wrought-iron, so arranged as to work in the slides, and is raised by means of two vertical rollers turning in opposite directions, which are made to bear upon the bar by an exceedingly simple arrangement of levers. A slight pressure upon the handle of one lever raises the hammer to any height not exceeding 7 feet; the pressure being removed it falls by its own gravity; this lever is also arranged so as to stop the hammer in any part of its descent, should circumstances render it necessary. The friction rollers are put in motion by means of straps and pulleys, fly-wheels being also fitted on each strap. Ibid.

BIBLIOGRAPHICAL NOTICE.

Principles of the Mechanics of Machinery and Engineering, by JULIUS WEISBACH, *Professor of Mechanics and Applied Mathematics, in the Royal Mining Academy of Freiburg. First American Edition. Edited by Walter R. Johnson, A. M., Civil and Mining Engineer. In two volumes; illustrated with* 1000 *engravings on wood. Vol.* 1.—*Theoretical Mechanics. Philadelphia: Lea & Blanchard,* 1848.

(Forming the 2d volume of the Library of Illustrated Scientific Books.)

In our notice of the first publication of this series, Müller's Physics, we ventured to express the hope that the succeeding volumes would be more worthy of the pains bestowed upon their getting-up; and we are gratified to find that our hope was not a vain one. The work, whose title is given above, appears to us, from the hasty examination which we have been able to give it, in every way worthy of being recommended to our readers. It is, as its title professes, a treatise on Mechanics, in especial reference to its applications to Machinery and Engineering. The divisions of the subject are very well arranged, and appear to be treated of in a very masterly manner. We fear, however, that the mathematical character of the book, and the sometimes complicated appearance of its formulæ, may detract from the popularity which it deserves. If the numerous and beautiful illustrations with which it abounds prevent this from being the fact, it will produce the very desirable effect of familiarizing our mechanics with mathematical notation, and thus the book will do a double benefit to science.

We have not had time, since the book was laid upon our table, to give it the attentive study which a work of this kind requires, and which this appears so well to deserve. This we purpose to do hereafter. In the meantime, a cursory examination of it, authorizes us to recommend it to students of the science of which it treats, as the production of a gentleman thoroughly competent to the task which he has undertaken.

The additions and remarks, by the American editor, are judicious and excellent, and the wood-cuts are decidedly the finest specimens of illustration of this kind that we have ever seen. We hope soon to see the second volume. F.

FRANKLIN INSTITUTE.

Proceedings of the Stated Meeting, held April 20th, 1848.

S. V. Merrick, President, presiding.

Present, 44 Members.

The following donations were announced:

From Hon. Jno. W. Farrelly, M. C., Washington City, D. C.—
The President's Message at the commencement of the 1st Session, 30th Congress.
From Hon. T. O. Edwards, M. C., Washington City, D. C.—
The President's Message at the commencement of the 1st Session, 30th Congress.
From the Royal Astronomical Society of London—
Their proceedings for January 14th, 1848.
From the Apprentices Library Company, of Philadelphia—
Their Annual Report for the year 1847.
From Hon. Edmund Burke, Com. of Patents, Washington City, D. C.—
Catalogue of the Library of the Patent Office, 1847.
From Hon. William Jackson, Massachusetts—
Annual Reports of the Railroad Corporations of the State of Massachusetts, for 1847—Legislative Document, No. 26.
From Messrs. Lea & Blanchard, Philadelphia—
Principles of the Mechanics of Machinery and Engineering, by Julius Weisbach, 1st Am. ed., vol. 1—1848.
From Richard C. Taylor, Esq., Philadelphia—
Report of the Stockholders of the Dauphin and Susquehanna Coal Company, 1848.
From Thomas U. Walter, Esq., Philadelphia—
Final Report of the Building Committee of the Girard College for Orphans, to the Councils of the City of Philadelphia, also a Report to the Building Committee, by T. U. Walter, Architect.
From James S. Lippincott, Esq., Philadelphia—
The Antiquities of Rome, to which are prefixed two Essays concerning the Roman Learning, and the Roman Education, by David Kennett.
The Teacher: or Moral Influences employed in the Instruction and Government of the Young, by Jacob Abbott.
The District School: or National Education, by J. Orville Taylor.
From Charles E. Smith, Esq.—
New York Legislative Documents, viz:
No. 102, Annual Report of the Secretary of State, relative to Railroad Statistics, March 4th, 1847.
No. 132, Annual Report from the same, on the same subject, March 7th, 1848.
From John Merrick, Esq., Hallowell, Maine—
Specimen of Iron Ore, from Dover, Maine.

The reports from the Officers and Standing Committees were received.

On motion, it was—

Resolved, That the Committee on Exhibitions be, and they are hereby instructed to take the necessary steps to hold an Exhibition of American Manufactures, next Fall, agreeably to their recommendation this evening.

On the report of the Special Committee, appointed at the last meeting, the following resolutions were unanimously adopted, viz:

Resolved, That the members of the Franklin Institute have heard with the most profound sorrow, that Dr. Thomas P. Jones, one of the earliest of their associates, departed this life on the Eleventh day of March last, after a long career of usefulness in the walks of mechanical science.

Resolved, That the services of Dr. Jones, as the founder and able editor of the Journal of the Institute, from the time the publication of it was commenced until his death, and also for several years as the Professor of Natural Philosophy and Mechanics in the Institution, will ever be gratefully remembered by all who have participated in the labors and advantages of our society.

Resolved, That we sincerely condole with the family of Dr. Jones, in their recent and irreparable bereavement, and that a copy of these resolutions be transmitted to them by the corresponding secretary.

Communications on subjects connected with science and the arts, being called for;

Mr. A. W. Whitney exhibited his patent Improved Wiring Machine, a description of which will be found at page 384 of the present number of the Journal.

Mr. Williams submitted to the inspection of the members two Foot-warmers, which present a singular phenomenon. They consist of boxes of polished zinc for the purpose of containing hot water, and are covered with cloth embossed in different colors, lined with calico. The pattern embossed upon the cloth has imprinted itself upon the zinc, the metal being tarnished under the black, and having remained bright under the other colors.

Mr. Cardeza exhibited a rifle constructed to load at the breech, and made from his drawings in 1846. The gun was familiar to some of the gentlemen present, having been used in that year, in experiments upon the explosive force of gun-cotton. His reason for exhibiting it was, that a patent for the same thing had recently been taken out by a resident of New York.

Mr. Smith exhibited a solution of gun-cotton in ether, and explained the advantages which it has as a dressing for wounds. He stated that a careful microscopic examination of it, showed no fibrous structure, and gave no traces of the polarization of light, as had been affirmed.

Dr. Rand presented to the meeting, a patient who had been operated on for a cyst on the right elbow—the wound having been dressed with the ethereal tincture of gun-cotton. It had succeeded admirably—and allowed such free action of the joint during the healing, that the individual had been able to pursue his trade, that of a weaver.

Prof. W. R. Johnson stated that gutta percha dissolved in chloroform, and gave a very similar substance by evaporation, which in addition to the advantages possessed by the tincture of gun-cotton, was more elastic, and therefore permitted of still freer motion without injury to the dressing.

Mr. Plotts explained the theory of his method of rational arithmetic, by means of which children could be taught so as to understand and explain every step which they are obliged to take in solving any problem presented. Mr. Plotts exhibited specimens of his method and illustrated the facilities which it gives.

Mr. M. T. W. Chandler called the attention of the members to a very beautiful model of a weigh-lock, on the plan of Messrs. Ellicott & Abbott's platform scale, which is now under examination by the Committee on Science and the Arts. The crib on which the boat rests while being weighed, is sustained by rods which operate on a series of steelyards, arranged longitudinally on each side of the lock. From these the strain is transferred by means of a rocking shaft, to another steelyard, placed above the lock and transversely to it, on which the weighing is effected.

Dr. Hare communicated to the society some inferences and facts tending to explain the contradictory impressions which have existed respecting the competency of fused nitre to explode with water or carbonaceous combustibles. As his remarks were of great interest and importance, and cannot be condensed within the limits which we have at our disposal now, we refer our readers to the next number of the Journal, in which they will be given in full.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Lieut. Stelwagon's Coast Survey Sounding Apparatus.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination—The Gedney Coast Survey Sounding Apparatus, invented by Lieut. H. S. Stelwagon of the United States Navy, Report—

That they have carefully examined this instrument, and made several experimental trials with it which have been very satisfactory. It differs from the ordinary deep sea lead, in having a projecting stem of iron fixed in the lower end, which carries a conical iron cup screwed upon its lower extremity. A disk of leather slides upon the stem between the cup and the end of the lead, forming a valve which rises when the lead is passing down through the water, and allows the conical cup to receive portions of the soil into which it penetrates on reaching soundings, and falls upon the cup when it is drawn up so as to preserve its contents from being washed out as it passes rapidly through the water. Upon unscrewing the cup after a throw of the lead, a small portion of the bottom soil is found securely lodged within, having exactly its natural proportions of fine and coarse particles unchanged by washing.

The Committee has no hesitation in commending this instrument, as much superior to the ordinary lead, both for scientific and ordinary maritime purposes, and its simplicity is such, that any one capable of using the common lead, can use this with equal facility and with more certain and satisfactory results.

By order of the Committee.

William Hamilton, *Actuary.*

Philadelphia, Feb. 10, 1848.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

JUNE, 1848.

CIVIL ENGINEERING.

On Sub-Marine Foundations; particularly the Screw-pile and Moorings. By Mr. A. Mitchell, of Belfast, Assoc. Inst. C. E.

Considering that the entire subject of the various sorts of piling, of solid stone foundations, of coffer-dams, of masses of concrete, and the numerous modes adopted by ingenious men for overcoming local difficulties, would occupy too much time, and scarcely possess novelty, the author restricted himself almost entirely to the description of the works executed by him with the screw-pile, as that had been chiefly employed for supporting structures on loose sand or mud banks, wholly or partially covered by the sea, where it had been previously considered very hazardous, if not impracticable, to erect any permanent edifice; and in his narrative, he scrupulously avoided all comparison with other modes of proceeding, even when they had the same object. The origin of the screw-pile was the screw-mooring, which was designed for the purpose of obtaining, for an especial purpose, a greater holding power than was possessed by either the ordinary pile or any of the usual mooring-anchors, or blocks, of however large dimensions. It was proved by experiment, that if a screw, with a broad spiral flanch, were fixed upon a spindle, and forcibly propelled by rotary motion to a certain depth into the ground, an enormous force would be required to extract it by direct tension; and that the power employed must be sufficient to drag up a mass of earth of the form of the frustrum of a cone reversed—the base being at the surface of the ground, and the section of the apex being equal to the diameter of the screw. The extent of the resisting mass must, of course, depend upon the natural tenacity of the soil. Even in this reasoning, it must be evident that a vertical force was calculated upon; but as, practically, that seldom if ever occurred, the angle of tension and the curve of the buoy-cable again gave the moorings greater power. This was found to be correct in practice, and the application of the moorings became very extensive. An arrangement was made with the port of Newcastle-on-Tyne, by which, for the sum of 2500*l*, the right of fixing these moorings in the Tyne was given; and Mr. Brookes, the engineer, showed that last year, whilst in the neighboring port, damage was done to the shipping to the extent of nearly 30,000*l*., no injury was sustained in the Tyne, entirely owing to the sound holding of Mitchell's screw-pile moorings. It naturally occurred to Mr. Mitchell, that the same means of resistance to downward pressure might be used; and he proposed to apply it for the foundations of lighthouses, beacons, and other structures, which, for maritime purposes, it might be desirable to place upon sand and mud banks, where hitherto it had been considered impracticable to place any permanent edifice. In the year 1838, a plan for a structure of this nature for a lighthouse, on the Maplin Sand, at the mouth of the Thames, was laid before the corporation of the Trinity House, supported by the opinion of James Walker, Esq., their engineer. The nine iron piles, 5 inches diameter, with screws 4 feet diameter, were accordingly driven 22 feet deep into the mud, and, with proper precaution, they were allowed to stand for two years before any edifice was placed upon them. The lighthouse was subsequently constructed, and, as was testified by Mr. Walker, had stood perfectly until the present time. Pending this probation, it was determined to erect a lighthouse to point out the entrance to the harbor of Fleetwood-on-Wyre, and under the advice of Captain Denham, R. N., the screw-piles were adopted. The spot fixed on was the point of a bank of loose sand, about two miles from the shore; seven iron piles, with screws of 3 ft. diameter, were forced about 16 feet into the bank, and upon them timber supports 48 feet in vertical height were fixed to carry the house and lanthorn. This structure was completed in six months, and was perfectly successful, never having required any repairs to the present time. A similar lighthouse was erected near Belfast; and since then several others, with a great number of beacons, have been fixed in situations heretofore deemed impracticable.

A project was started by the Earl of Courtown, in the year 1847, for adding to the length of the pier at the Harbor of Courtown, on the coast of Wexford, which had proved an entire failure, from the channel between the solid pier being continually choked up with sand. Iron piles, with screws of 2 feet diameter, to be driven from 11 feet to 15 feet into the sand, and blue clay, were decided to be used in order to form an open jetty through which the sand could be washed by the current, and the platform would be used for loading and discharging the shipping. The surf was so heavy on the coast that the usual barges or floating rafts could not be used for putting the piles down—so an ingenious plan was designed by Mr. Mitchell, for projecting a stage forward from the solid part, rigging a large grooved wheel upon the top of the pile, passing an endless rope-band around it, and round a pulley fixed 150 feet back, and then, by a number of men hauling upon the band, a rotary motion was communicated to the pile, which screwed it down very fast. By these means one bay of the pier, 17 feet long, was finished daily, even in very rough weather. The entire length of the jetty was 260 feet, its breadth 18 feet, with a cross-head 54 feet long, with landing stages at each end, and two lines of railway throughout. The entire cost of this extension was 4150*l.*, or about 47*l.* 10s. per lineal yard—an extremely small sum compared with the cost of stone piers; but even that was more than the expense would be now, as the system of work is better understood, and materials are now cheaper. The account of the difficulties incurred in the execution of these works was most interesting, and ample testimony was borne by engineers of eminence, and men whose maritime experience gave weight to their opinion, of the superiority of Mr. Mitchell's screw-piles and moorings over every other system for holding buoys or for supporting beacons and lighthouses, and their use was suggested for the foundation of bridges, viaducts, and numerous railway and other works, as well as a multiplicity of applications which had not hitherto been thought of.

Mr. W. A. Brookes gave an account of the method of laying down the moorings at Newcastle-on-Tyne, under his directions. A heavy chain, formed of 3¼ inch round iron, in links of 3 feet long each, was stretched along the bed of the river, in the direction of the current. To this chain beneath each tier, was attached a 2½ inch mooring-chain, fixed to the head of a screw mooring; another screw being also placed beneath each tier, and driven down between 10 and 20 feet into the clay, and sometimes full a foot into the shale rock. The screws were 4 feet in diameter, and were placed in depths varying from 15 feet to 24 feet at low-water spring tides. They were screwed down to the depth of 15 feet in an hour and a half, and sometimes 21 feet in two hours. Each mooring-screw was intended to have borne the strain of four heavy ships; but, during the last winter, the port was so crowded, that more than double the proper number of vessels were moored upon each: and yet there were no signs of weakness; and whilst nearly 30,000*l.* of damage was done at Sunderland, during a heavy storm, no casualties occurred at Newcastle, which Mr. Brooks stated was entirely owing to the sound holding of the screw moorings. He argued, therefore, that the small sum of 2500*l.*, paid by the harbor commission of Newcastle for the right to put down these moorings, was a very wise expenditure.

Mr. T. Smith, Pilot Master of the Port of Shields, corroborated Mr. Brooks's statement.

Captain Washington, R. N., had, in the course of his surveying duties, seen the screw moorings in almost every position, and had heard them universally eulogized, as being the best and safest moorings hitherto known. He strongly recommended their employment. He had also examined carefully the screw-pile lighthouses, and had every reason to be satisfied with them, as affording a means of placing lighthouses and beacons where they were before impracticable, and enabling floating lights to be generally superseded by fixed lights, which latter he proved, from documentary evidence, to be one-third less annual cost than the former, and certainly more useful to sailors; for, in spite of all the care, attention, and even lavish expenditure of the Trinity Board to moor the lightships securely, they did go adrift just at the time when they were most required. He, therefore, advocated fixed lights in every situation where a foundation could be obtained; and he believed that, with the screw-pile, there were scarcely any situations where this could not be accomplished.

Messrs. Walker, Cubitt, Rennie, Murray, Moorson, Mitchell, Scott, Russell, and others, took part in the discussion, adducing instances of the efficacy of the moorings and the piles, and of their applicability to numerous engineering works, for which they expressed their intention of employing them. The high price hitherto charged for the right of using them had somewhat retarded their general introduction; but it was explained, that Mr. Mitchell had feared to entrust to others the fixing of them, lest a failure might ensue before his system was perfected, which, however, he now thought it was. Now, however, as the right of granting licenses for their use was transferred to men of business who had purchased it, there was no doubt of their being brought within the reach of every application.—*Proceed. Inst. of Civ. Eng.* Civ. Eng. & Arch. Journ.

Remarks on the Formation of the Entrances to Docks, situated upon a Tideway. By Mr. J. B. Redman, M. Inst. C. E.

After illustrating the subject by the example of the position and direction of all the principal dock entrances on the borders of the Thames in the port of London—showing that the variation in the opinions and practice of engineers had been very great—the paper detailed the ordinary methods of docking and undocking ships, and the precautions to be taken in constructing entrances, which should be best adapted for facilitating these operations; and, although it was difficult to lay down any positive rules upon the subject, as the engineer must, in almost every case, be guided by local circumstances, yet in ordinary cases the following general rules were recommended:—For graving docks, an angle of about 45°, pointing up the stream; for wet docks, an angle of about 60°, in the same direction; and a right angle, with the stream, for building ships. These, it was believed, would be generally found the most available.

In the discussion upon Mr. Redman's paper, the merits and defects of the several dock entrances in the Thames and in other situations were examined, and the general result appeared to be, that although the engineer must be guided by local circumstances, yet, that in situations where the river was sufficiently wide, and the position of the land permitted, an acute angle pointing up the stream, was the best for docking vessels with the flood—that the reverse would be best for undocking ships. In ordinary widths of rivers, therefore, the end would be attained by forming a bay sufficiently deep to render the water still in front of the dock, the wing walls being so much splayed as virtually to give the directions up and down the stream as circumstances required. The peculiar positions of the docks at Ipswich, by Mr. Palmer, the alterations of the Duke's Dock at Liverpool, by Mr. Cubitt, and other cases, were sustained in support of the arguments of the speakers, who all united in praising the industry and talent of Mr. Redman, in bringing forward the subject in the complete manner he had done.—*Ibid.* Ibid.

An Account of the Effect of the Storm of the 6th of December, 1847, *on the Coast near Edinburgh, as illustrating the Principles of the Construction of Sea Defences. By* W. J. M. Rankine.

The principle example given was the sea wall of the Leith branch of the Edinburgh and Dalkeith Railway, built by the author in the year 1837, from Mr. Walker's designs. Just after it was completed, a violent storm occurred, which injured almost every similar work within its range, but produced no ill effect upon that structure. On the 6th of December 1847, a still more violent storm occurred, which did great damage all around, but the railway wall still escaped without injury. The total length of the wall was about 750 yards; its height was 13½ feet above the beach at the highest point, diminishing to about 6 feet at the ends. The height of the top was 4 feet above equinoctial spring tide level. Its least thickness was 5 feet and its greatest 10 ft.; the back was vertical, but the face had an inclination at the lower part of 5 inches in the foot, gradually becoming curved as it rose upwards, until at the top it overhung slightly. The foundation course was composed of large flat stones, laid horizontally 4 feet below the surface of the beach, upon a stratum of fine sand and gravel, firm when dry, but movable when wet. The face was of hammer-dressed ashlar, about 2 feet thick; the back of rubble, 18 inches thick. The interior was filled with concrete. The coping was composed of stones each weighing about half a ton, connected by means of cast-iron dowels. The stone used was Craiglieth sandstone. The face-joints were laid in cement for a depth of 4 inches. The foundation was protected by a pitching of trap boulders, laid on the natural level of the beach. They were partially disturbed by the storm referred to, and the author ascribed this to their weight being insufficient to resist the vertical oscillation of the waves.

The second example was a vertical sea wall near Trinity, the foundation of which was protected by a dry stone bulwark sloping at angles of from 30° to 40°. The wall was injured by the storm, but the pitching was breached at several points.

The third example was another wall near Trinity, of a hyperbolic section. The lower part had a slope built dry up to a little below high-water mark. At this point there was a sharp curve, and the upper part was nearly vertical, and laid in mortar. The waves extracted the stones of the curved portion, and the upper part, being undermined, was destroyed to a great extent.

The last example was the bulwark of the Granton line, the lower part of which sloped at about 20°; the upper portion was curved, and was covered by a heavy projecting string-course and parapet. It was built dry, and the stones of the lower part weighed not less than half a ton each. This bulwark suffered damage to a slight extent on its upper portion.

These examples were stated to confirm the following principles:—That the principal action of the waves in front of a sea wall was a vertical oscillation, produced by the combination of the direct and the reflected waves; that a sloping bulwark gave rise to a sloping oscillation, tending to overturn any portion which projected above the line of slope; that where the strength of a sea wall depended on the pressure of the superincumbent masonry, and the adhesion of mortar and cement, the position of greatest stability was vertical; and that when the strength depended on the weight of the individual stones, the position of greatest stability was a very flat slope.

In the discussion which ensued, instances were adduced of the duration of vertical walls under the attacks of heavy seas, and, on the other hand, of their destruction when flat slopes had effectually resisted the waves; and it was agreed that in this, as in all other cases of engineering, no empirical rules should be laid down, but that the skill of the engineer should be exerted to adopt such forms of construction as were best adapted to the locality and the circumstances.—*Ibid.*

Ibid.

Description of the Tubular Bridge to convey the Chester and Holyhead line of Railway over the river Conway.

As this bridge which is constructed to carry the Chester and Holyhead line of Railway over the River Conway, is a unique example of engineering skill, we purpose giving a brief description of its nature, and of the effort made to raise it to its ultimate destination.

The idea furnished by the word "tube," gives no idea of its form, inasmuch as that is suggestive of a circularly-formed tunnel, whereas in fact, the bridge rather resembles a huge chest, such an one as the genii of the Eastern romances might be supposed to fabricate.

The Tube is made of wrought-iron plates, varying in thickness from ¼ inch to 1 inch, rivetted together, strengthened by T irons; and, to give additional strength to the whole, a series of cells is formed at the top and at the bottom of the tube, between an inner ceiling and floor and the exterior plates. It is to be observed that T irons strengthen the top and sides, and the iron plates which form the cells are rivetted and held in their places by angle irons. The upper cells, eight in number, in the transverse section, are nearly square, being 1 foot 9 inches high, and 1 foot 8¼ wide. The lower cells, six in number, are 2 feet 3½ inches wide, by 1 foot 9 inches high. The space between wall and wall, if we may so speak, of the tube, is 14 feet, and the height of the whole, inclusive of the cells, is 22 feet 3½ inches at the ends, and 25 feet 6 inches at the centre The total length of the tube is 412 feet. One end of the tube will be fixed to the masonry of the pier, but the other end will be so arranged as to allow for the expansion of the metal by the action of atmospheric variations, and will therefore rest upon eleven rollers of iron, running on a bed plate; and, that the whole weight of the tube may not be carried by these rollers, six girders are carried over the tube and rivetted to the upper parts of the sides of the tube, and these side portions rest upon 12 balls of gun metal running in grooves, which are fixed to iron beams let into the masonry.

The machinery for raising this stupendous piece of iron-work consists of two hydraulic rams, one at either pier. The rams are fixed on massive bearing girders, which are firmly bedded in the masonry of the piers. There is a bearing girder, and another iron girder is fixed into the piers about 18 feet above the bearing girder; and into this the guide rods from the press, to steady the cross-head when in action, are fastened. The screws of the clams or vices for clipping the chains, are turned by wheels, the upper clams being used for "clipping," or holding fast, whilst the ram is rising and lifting the chains, and the lower ones, after the ram has risen, to hold the chains in their places, and prevent them from slipping, whilst the cross-head comes down to take a fresh lift. The chains are of wrought iron, each link six feet in length from centre to centre of pin-holes; and they have shoulders at the end of the links, into which the clams fit when closed, and thus they are effectually prevented from slipping down. The sides of the clams, or vices, being moved by right and left screws, they require but *one* man to each pair of wheels to open or close them. At each lift the tube is raised six feet. The cylinder, within which the ram works, is 3 feet 1½ inches in diameter, outside measure; and the hollow for the ram is 1 foot 8 inches in diameter.

The cross-head is 9 feet 10 inches wide, and 2 feet 5½ inches deep; the apertures for the guide-rods are 6 inches in diameter, and those for the chains are 2 feet 1 inch long, by 1 foot 1½ inch wide. The guide-rods are 11 feet 3½ inches long between the cylinder of the ram and the cross-head.

The case of the cylinder is not square in plan, but is longer than broad, being 5 feet 2 inches in length, by 3 feet 9 inches in width; and strong ribs spring from the corners and longest sides to strengthen it.

The space allowed for water is very narrow all round the ram, and there is a deep collar at the top of the cylinder, at which part the space for water is stopped, and a water-tight joint is formed by means of a leather packing in it.

The aperture for the entrance of the water into the cylinder is bored through the collar, and is only three-eighths of an inch in diameter; and the quantity of water each cylinder will hold is 66 gallons.

Each press, being 18 inches diameter, equals 324 circular inches; and, being worked under a pressure of 3 tons per inch, will lift 972 tons; but it is calculated they would bear four tons per inch, and be capable of supporting the enormous weight of 1296 tons. The Conway tube is about 1300 tons weight, and each ram, therefore, has to lift but 650 tons.

The water is forced into the cylinders by means of steam engines fixed between the vacant piers, on which the second tube will ere long be placed. The engines are on the high-pressure principle, with the cylinder placed horizontally. The piston-rod passes through stuffing-boxes at each end of the cylinder; a cross-head is connected to the piston-rod, giving motion, by side rods and cranks, to two fly-wheels, one placed on each side of the engine. Into the piston-rod, at each end, the plungers of the forcing pumps are fixed, having a stroke equal to the stroke of the steam piston. The steam piston is 17 inches in diameter; the plunger of the pumps $1\frac{1}{16}$ inch diameter; and the length of the stroke is 16 inches. The boilers are on the tubular principle, somewhat like those of the locomotive engine, but without circular fire-places. The whole being very portable, is fixed on a frame-work of wood with very little trouble.

On the 6th ult. the labor of raising this vast tube was very nearly accomplished. The tube, which at first was resting on part of the platform on which it was built, was raised eight inches by pumping the water out of the pontoons, which had been placed under it. At about eleven (the tide still on the flow) the whole fabric was got under weigh, and slowly drawn down by means of hawsers attached to various convenient places, and worked by capstans, until it arrived within a few feet of its proper position at the north side, and in its right position at the south, or Conway side, when, owing to the pontoons on that side touching the bottom, it could be got no farther, and the tide receding, the tube was left unsupported on the two temporary stone-beds, built inside the abutments. With this single, and, indeed, trivial, exception, the whole operation was performed in a most satisfactory manner.

The tube was floated to the piers on six huge pontoons, three at either end, constructed near the spot where the tube was erected. The pontoons are 100 feet in length, 25 feet in width, and 10 feet high.

The pontoons were floated under the platform on which the tube rested at low water; and the piles supporting the platform being taken away, the whole mass of the tube rested upon two stone piers, temporarily erected at either end for that purpose; but as the tide rose, the pontoons lifted the tube from these piers, and transported it to the shelf prepared for it below the presses on the permanent piers. The tube bridge floated with the greatest ease, and not submersing the 6 pontoons on which it rested (three at either end) to within at least 3 ft. of their decks. The precautions taken by Captain Claxton, R. N., to whose sole direction the transporting of this enormous mass was committed, were contrived to keep the machine suspended over its fixed piers, to await, as it were, the decision of the engineer as to whether the perilous step of launching into the deep (for the river is 12 fms. at low water) should be proceeded with; or whether the valves should be lifted, and the tube dropped, as it were, again in place, upon its piers, many circumstances appearing to bear upon that determination —the strength of the current, the height to which the tide promised by its comparative rising, and the strength of the wind. The tide however, appeared to slack, and the resolution was formed, for the chains and ropes were hove upon, and in ten minutes it had passed the first rubicon—gradually, but steadily, it approached the site intended for it. In the pontoons, three enormous masses of timber, 95 ft. long by 25 ft. wide, and 8 ft. deep, bound together with powerful crabs, worked by 44 men, hove upon the chains, which had previously been tightened up by a large crab, at which a dozen or more men strained with their utmost efforts at either end on shore—one end of each chain being fixed at the piers of the suspension bridge, while the other ends were fast to the crabs, on the opposite side of the river; on these chains the pontoons appeared to traverse. The western, or Conway end, was pointed first, but did not come quite home afterwards. The eastern, or Chester end, was dropt in after, or while the ebb was making, but before it reached, by about a dozen feet, the exact berth, it took the mason work, and no effort could disengage it. Nevertheless, it was over its bed, sufficiently to be landed and bedded up with timber previously prepared from a lower bed, which had been provided in case the tide should fall before the upper bed could be reached. The most extraordinary efforts were made, with screws and tackles, no less than four of which latter were at one time applied, besides the Chester side crab, manned by sixty people, while the tide was falling, to overcome the obstacle; but they appeared to be ineffectual, and Captain Claxton gave orders for bedding up, which was speedily accomplished. The barges were then sunk a little, and the fabric rested very near the hydraulic presses which are to be used in raising it. Three steamers were in attendance below the bridge, two full of company, and a great number of boats plied with their freights on the river. The way in which, in a tideway never really still, this enormous structure was placed upon its bed, reflects the greatest credit on all concerned, down to the lowest laborers. All seemed to be excited and actuated by the liveliest desire for success. We were told that eighty men were in each set of pontoons—one set commanded by Captain Dunce, R. N., an assistant of Mr. Brunel, and the other set by Lieutenant Blatchly, R. N.; the crews under them, performing the principal work, being sailors from the Home of Liverpool, of whose admirable conduct in Conway we heard high encomiums. In the tube, attending the hawsers, were the officers and some of the crew of the *Great Britain*. On the top, on the Conway side, Mr. Fairbairn, of Manchester, had the direction; and, on the Chester side, Lieut. Glenny, R. N. The great difficulty to be overcome was apparent—the space to play in; for, on the Conway side, it wants nine inches, by actual admeasurement of our correspondent, of being home, or in place; while on the Chester side, it is fairly jambed against the masonry, so, that, in fact, there were barely 9 inches free in 400 feet. No sooner had the tide fallen sufficiently, than the obstacle to the exact fixing in position became apparent to all. The inner pontoon was butting at its end against and partly upon a rock. It took the ground which had been blasted away from the solid rock—in consequence of having got a little twisted previously to starting, we were assured, full 4 feet.

Since writing the above description, we have the gratification of announcing that the tubular bridge has been safely lodged in its proper position on the lower piers of masonry—and is now most admirably adjusted for the attachment of the chains, by which it will be lifted into its permanent resting-place. The tube was again floated by means of the pontoons, in the presence of Mr. Stephenson, Mr. Fairbairn, Captain Claxton, and the other engineers and nautical gentlemen who have throughout directed the operations. Both Mr. Stephenson and Mr. Fairbairn have been incessantly occupied at Conway since the commencement of the operations; and we may safely congratulate both those gentlemen, and the profession generally, on this successful accomplishment of the greatest engineering triumph ever attempted. It is expected that the line of railway will be opened from Chester to Bangor in the course of the ensuing month. London Artizan.

Gauge-pipe, or Apparatus for Measuring the Constant or Variable Product of a Flow of Water, during any given time.

A report from Messrs. Poncelet, Piobert, and Morin, reporter,—a committee of the French Academy of Sciences, appointed on a memoir relative to this subject by M. A. Lapointe, is contained in the "*Comptes Rendus*" of November 2, 1847. The importance of this subject, in the application of water as a moving power for machinery, or other practical purposes, will be understood by all who are aware of the difficulty of ascertaining, with the requisite degree of precision, the quantity of water expended under variable circumstances, during a given period of time. The different results produced by a particular arrangement of the apertures; a change of rapidity in the revolutions of the wheels; a variation of the level in the head and fall; and other modifying causes,—are such as to show that it is by no means easy exactly to appreciate them in experiments upon the effect of water power.

An apparatus which would, by the mere inspection of an index, and the application of a simple form of calculation, give at once the quantity of water flowing through a known orifice, in a given time, would be a contrivance of great utility to engineers and others charged with, or interested in, the application of hydraulic science to ascertain practical effects. Many attempts have been made to solve this problem, most of which have been directed to the determination of the mean velocity of the fluid in a section of known surface, thence deducing the volume of the flow. M. Lapointe proposes to ascertain immediately, and without other measurement than the inspection of an index, the quantity of water flowing through any aperture, and under all circumstances.

According to the description given by the committee, the apparatus used by him consisted of a cylindrical pipe, furnished with a little wheel with helicoid wings, the axis of which corresponded with that of the pipe, and which gave motion to an index placed above the water, and within sight of the observer. The tube, widened at its mouth in a form similar to that of the contracted vein issuing from a circular aperture, is fastened, by means of a flanch and bolts, to the dam of plank which prevents the passage of any water except through the pipe. The axis of this pipe is horizontal, and it is placed so low that its upper edge may be always beneath the level of the water below the dam, which will, in all cases, ensure a full flow from it.

The wheel is placed in the axis of the pipe, and at such a distance from its mouth, that the parallelism of the filaments of water may be established by the time they reach it. The axle of the wheel imparts movement by a bevel gearing to a very light vertical spindle which rises from the pipe, above the level of the water, and moves an index, by which, when the apparatus is at work, the number of revolutions made by the wheel, in any given time, may be determined without stopping or changing the motion.

It will be readily perceived that when there is a difference of level between the water on opposite sides of the dam, there will be a current passing through the pipe, and that the wheel will begin to turn so soon as the action of the current overcomes the passive resistance of the apparatus. The velocity of the wings, or the number of revolutions made by the wheel, increases, then, with the difference of level, or with the expenditure of water, according to a law which was left to be determined, by direct experiments, whether it was sufficiently simple to render the application convenient and certain.

For this purpose M. Lapointe made the following experiments at one of the races of the powder works at Bouchet. The outlet of the face, where it emptied into the general canal of discharge, was closed by a dam of planks, in which were made three apertures, each being three-tenths of a metre square, and encased with sheet iron. Gates, also of sheet iron, were worked by screws, so as to allow, in each experiment, of the passage of all the water which presented itself, and thus to maintain a constant level above the bottom of the orifices. The flow through these apertures, the edges of which were sharp,—the contraction complete entirely around them, and which were very similar in arrangement and dimensions to the apertures studied by Messrs Poncelet and Lesbros,—may be estimated by the results obtained by these practised observers.

The gauge tube was placed in another dam, at a sufficient distance from the former, and above which a constant level was established and maintained during each experiment.

The control and constancy of the levels being thus acquired and ascertained, it was certain that the gauge pipe and the little measuring gates delivered equal volumes of water in the same period of time. One of the observers remained near the little gates, to be certain that the level was constantly maintained; while the other took post at the gauge pipe, to observe the number of revolutions made by the wheel per minute; using for that purpose one of Breguet's counters.

In the first experiments, of which the results are given by M. Lapointe in his memoir, he operated in this manner with constant levels:

the differences in the height of water above the dam, and that below it, being comprised between ·06 and ·24 metres.

Now, taking for abscissas the volumes of water expended in a second, and for ordinates the corresponding number of revolutions of the wheel,—he has shown that all the points thus determined fall upon the same straight line, which intersects the axis of the abscissas in advance of the origin of the co-ordinates. From which he concludes: 1. That the movement of the wheel does not commence unless there flows, in a unit of time, a certain volume of water: and, 2, That for the different volumes of water discharged in a unit of time, the increase in the number of revolutions of the wheel is proportional to the increase in the volumes expended.

The law, therefore, which connects the number of revolutions with the corresponding volumes of water expended in a unit of time, may, when the rule is established, be represented by the simple equation of a right line, $Q=a+bn$;—in which Q represents the quantity of water discharged in a second;—a and b the constant numbers furnished by the observations, and which, for the wheel used, have the following vaues: $a=\cdot0635$ cubic metres; $b=\cdot01247$ cubic metres;—and n the lnumber of revolutions in a second.

In comparing the results of this practical formula, $Q=\cdot0635$ cubic metres $+\cdot01247\ n$, with those of the direct observations, it was found that the greatest variation of the result of the formula from that which was furnished by the observations at the gates, was $\frac{1}{40}$ of the latter; and this difference, which is sometimes in excess and sometimes in defect, should be rather attributed to errors of observation at the gates, than to the instrument itself.

It was therefore established, by these first experiments, in which the volumes discharged per second varied from ·131 to ·372 cubic metres, that, when the discharging and receiving levels continued constant, the above formula will enable us directly to calculate the expenditure, by knowing the number of revolutions made by the wheel. But as in these experiments the operations were successively conducted at different velocities, it was natural thence to conclude that the relation between the velocity of the water, or the expenditure, and the number of turns of the wheel, was independent of that velocity, —or, that the co-efficients a and b of the formula were independent of the velocity;—and that consequently this formula ought to apply, with the same accuracy, to the measuring of water when the velocity was variable, as when it was permanent. This last consideration greatly extended the utility of the gauge pipe, inasmuch as it rendered easy the measurements under variable levels, and enabled observers to avoid one of the principal causes of error in experiments upon water power.

However plausible might be this conclusion which M. Lapointe had drawn from his first experiments, he rightly conceived that it was necessary to verify it by special experiments. For this purpose, and in order at the same time to extend the field of his observations, he obtained from the able engineers who have the direction of the Paris water works, authority to fix his apparatus between two of the great basins of Chaillot, the regular form of which is favorable to gauging by direct measurement of the volumes.

A trench of 1·40 metres in width, by 1·80 in depth, was made between the two reservoirs, and extended in the lower basin by a wooden trunk of the same size and about five metres in length; making the total length of the conduit about nine metres. At the entrance of this conduit is a gate, by means of which the flow of water from the upper to the lower basin may be regulated at pleasure. Below this gate was placed the dam to which was attached the gauge pipe previously employed at Bouchet. A second dam, placed at the outlet of the conduit, allowed the water of the lower level to be kept at a convenient height above the extremity of the pipe. The water which passed over the dam fell into a trough, in which were placed inclined planes to conduct the water down gently, that it might fall into the basin without causing too great an agitation of the surface.

A wooden float, so large as to be little affected by the waves on the surface of the water, sliding on a rod graduated to every five centimetres, was used for determining the elevation of the level.

The steam pump at Chaillot raises but about 140 litres of water in a second; but, on account of the excess accumulated in the reservoir, much more than this quantity could be used in operating with variable heads of water. At the commencement of a series of experiments, the upper basin was full, and the lower one almost empty; there was then a strong head, and the pipe discharged more than the pump supplied; in consequence of which the level above the pipe was reduced, as well as that below it; but the former more than the latter. The moving power, therefore, being equal to the difference of the levels, was constantly diminishing, until the pipe discharged but about 140 litres,—the flow and the supply being then brought to a permanent condition.

Ingenious arrangements having been made to that effect by the author, the observations of the height of level in the lower basin,—of the corresponding time,—and of the index showing the number of revolutions performed by the wheel,—were all made readily and simultaneously by the same person. In order to account for the difference in the values obtained for the constants of the formula in these experiments, it should be observed that the wheel and index used, had been altered in their proportions from those used in the first experiment.

These new experiments, to the number of 68, made under conditions of movement varied with the heads of water giving the velocity comprised between ·01 and ·435 metres, were graphically represented like the preceding, and in like manner showed that the relation between the volumes of water expended, and the number of revolutions of the wheel, is expressed by the equation of a right line. But here, in consequence of the changes made in the proportions of the wheel and the index, the values of the constant coefficients of this equation are $a = \cdot 024$, and $b = \cdot 02203$ cubic metres, which leads to the practical formula for calculating the flow per second, $Q = \cdot 024 + \cdot 02203\, n$; or, if the observation be continued during a period expressed in seconds by t, then $Q = {\cdot}024\ t + {\cdot}02203\ n$, in this case n being the whole number of revolutions during the time t. The discharges observed having been comprised between 77 and 423 litres in a second, it will be perceived that they varied nearly in the ratio of 1 to 5·5.

Two of the committee caused several of the experiments to be repeated. These were made indiscriminately with full and medium heads of water, and the results obtained agreed perfectly with those observed by M. Lapointe.

Another gauge pipe, intended for the discharge of a larger quantity of water, with a diameter of ·70 of a metre, was also tried at the basins of Chaillot. A series of 33 experiments, in which the difference between the upper and lower levels varied from ·03 to ·23 of a metre, and the expenditure from ·8158 to ·2338 cubic metres verified anew the proportionality of the discharges to the expression of the form $a+bn$. The graphic representation of the results gives for the constants a and b, the values $a = {\cdot}014$, and $b = {\cdot}0478$ cubic metres,—and consequently, for the practical formula, $Q = {\cdot}014 + {\cdot}0478\ n$.

The general result of these experiments is, that the gauge pipe, wheel, and index of M. Lapointe, furnish a simple, expeditious, and accurate means of determining the quantity of water which passes through the tube, either under constant or variable heads. Its application is not more difficult than that of any other method of measuring by dams, and is not subject to the same uncertainty. When the tare of the instrument has been once carefully established, it will at once give the volume of water desired to be known.

The diameter of the pipe being only limited to a size which will admit of being readily placed in the proper position; it will be perceived that by means of one or two pipes of this kind, streams of water may be measured which deliver several cubic metres per second. Such an apparatus would be of great utility in experiments relative to the employing of water power, in situations where the measurement is attended with many difficulties, and occasionally gives rise to disputes. But whatever care the author may have bestowed upon the determination of the practical formula, by the aid of which the discharge is computed, it is proper that this determination, which consists in what may be called the *tare* of the instrument, might be examined and verified in the presence of the parties interested, if there is a question in dispute;—and to this effect the author proposes to study the ratio which connects the number of revolutions with the pressure of the head of water in constant levels, by which he will be able to make this verification.

It was suggested by one of the committee, that a highly useful application of M. Lapointe's apparatus might be made by employing the wheel and index themselves, to limit and regulate the volume of water discharged by the pipe, independent of the time and the variation of level. Thus modified, the apparatus would become a real *water meter*, which would be of important service in the supply and distribution of water to cities; and above all, in cases where water is to be shared or divided between parties.

On the whole, the committee conclude that the gauge pipe of M.

Lapointe is convenient in practice, and that it supplies a quick and sufficiently exact means of measuring the flow of a stream; and therefore propose that it should receive the approbation of the Academy. The conclusions of the report were adopted.

For the Journal of the Franklin Institute.

An account of the Explosion of the Locomotive "Engineer," on the Reading Railroad. An Extract from a Letter.

The "Engineer" engine, belonging to the repairing department, started early on Monday morning, May 1st, from Pottstown, with a train of cars loaded with materials for distribution upon the line. When she left Pottstown, she was in charge of the fireman of the "Rocket" engine, named Christopher Gaffney, who proceeded as far as Reading, where the regular engineer of the Rocket, Wm. Nagle, was waiting to take charge of her. The reason why the fireman had charge of her from Pottstown to Reading, was, that Nagle, the regular engineer, had his family residing in Reading, and was in the habit of visiting them almost every Saturday evening, and spending Sunday with them, and on Monday morning would take charge of his engine as she passed Reading, as was the case on the morning of the accident.

Gaffney was considered a good man, and had frequently run engines for a week at a time, when anything occurred to make an extra engine necessary in that department.

The reasons why the engineers were changed, are simply these:—The "Rocket" engine, of which Wm. Nagle was the engineer, required some repairing to be done to her. She was taken into the shop under the direction of Wm. Sessford, engineer of the "Engineer" engine, who was considered a better mechanic, and had been in the habit of attending to all repairs of machinery in that department, although he was not considered a better engineer. While Sessford attended to the repairs of the "Rocket," Nagle was transferred to the "Engineer" engine, who had frequently run her, and other engines before, under similar circumstances.

When the "Engineer" left Pottstown, she had a train of eight eight-wheeled platform cars, lightly loaded with materials. She was blowing off freely, as was usually the case with her when starting, as she made steam fast while standing still. She was hot, but not dangerously so. She stopped several times between Pottstown and Reading, to unload materials, and when she arrived at Reading, she was not observed to blow off in a very remarkable manner, nor did she appear very hot. She stopped at the Reading station, about ten minutes, to take in wood and water, and then proceeded without any cause of alarm, on her way up the line. When about half a mile above the station, the explosion took place. The cause of the explosion is attributed to the low state of water, when she arrived at the Reading station, which is supposed to have caused the crown sheet of the fire box to become very much heated, and the pressure upon it being so great, that it forced it to give way.

There are other reasons given, causing the explosion—such as imperfection of the work, &c., but the opinion of those with whom I had conversation about this matter, and who I consider more conversant on the subject, agree that it was owing to the low state of water, when she arrived at Reading; and I have no doubt, if the matter was properly investigated, it would prove similar to that of the Neversink.

The engine was running backward at the time, and her position to the train, was, with her front or bumper attached to the cars, placing the tank of the engine at the head of the train. Her safety valve was found after the explosion, set at 80 lbs. to the square inch. The engine was not much shattered, but was thrown across the other track.

This, then, is all that I can give you in regard to this dreadful calamity, as both the engineer and fireman were killed by the explosion, who alone could have furnished us with a correct account, had their lives been spared. But as it is, we must attribute it to the most reasonable cause, although something else might have been the cause of the explosion.

Amount of Railroads in the United States.

It appears by a calculation made by a gentleman of this city, who has given much attention to the subject of our railroads, that before the taking of the next census, (two years hence,) there will be 6000 miles of railroad completed in the Atlantic States, north of the Potomac, of which, upwards of one-half lie east of the Hudson river. In this computation, the coal and quarry lateral railroads are included, but the withdrawal of these will not make any important deduction in the amount.

The Wear of Cast-Iron Rails.

I have had an opportunity of ascertaining, in the case of a railroad over which 200,000 tons weight were conveyed annually, during a period of eighteen years, (comprising the carriages and their loadings of coals in one direction—viz.: 150,000 tons; and the empty wagons only in the other—viz.: 50,000 tons,) that the mechanical waste from attrition was 1 lb. in every lineal foot of rail, (2 lbs. per foot of way,) or thereabouts, in the course of the time named, which is 587 lbs. per mile of road per annum, the rails being cast from cold-blast pig-iron. It may not be generally known, but I believe it to be true, that there is no chemical waste going on with rails in regular use—a certain degree of heat, occasioned by the loads passing over them, preventing oxidation. The wear of hot blast cast-iron rails will be considerably greater, and by breakage still more; it is, indeed, a very difficult matter to assign to them a competent weight and strength—one-half more metal, would, I much doubt, scarcely be sufficient for the purpose. I do not think it has yet been satisfactorily shown what the loss in weight, by wear, of malleable iron rails is, but it cannot fail to be considerably less than that of cast-iron. It is, indeed, a fact well known, and supported by theory, that the more highly iron is wrought, and the purer it is rendered, by being purged of earthy dross in its transmutation from the crystaline to the fibrous state, the stronger and more durable it will be, whether as regards its subjection to the action of fire, to attrition, or mechanical stress—in the character of engine grate bars, wagon way-rails, tye bars, &c.—*Thompson's Colliery Inventions and Improvements.* Lond. Mech. Mag.

List of American Patents which issued in the month of March, 1847, *with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents, in the U. S. Patent Office.*

1. For an *Improvement in the manufacture of Welded Iron Tubes;* Thomas Henry Russel, of Great Britain, March 6.

This is for an improvement in the method of welding iron tubes by the pressure of rollers. As heretofore done, the pressure to which the tube was exposed for welding, tended to separate the joint. To avoid this, the under roller is dispensed with, and instead thereof a rod is inserted within the tube, and called the beak, and this is bent up and enlarged at the forward end to form a rest against which the seam rests while under the pressure of the roller.

Claim.—"I claim the pressure roller which makes pressure on the cap joint for welding, in combination with the beak that resists the pressure of the rollers; when this beak is made of less diameter than the inside of the tube, and bent upwards to sustain the lap joint under the roller substantially as described, whether it be sustained by its attachment at the outer end alone, or by the under rollers as described, and placed between the point of the beak and its attachment."

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2. For an *Improvement in Folding and Measuring Cloth;* Elbridge G. Woodman, North Chelmsford, Middlesex county, Massachusetts, March 6.

We are under the necessity of omitting the claim as it could not be understood without the drawings.

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3. For an *Improvement in Folding and Measuring Cloth;* Arnold R. Austen (assignor of Simon D. Glines), Providence, Rhode Island, March 6.

Claim.—"I claim as my invention the employment of a horizontal sliding lathe, with measuring and folding scales or bars that fold and deposit the cloth in layers of one yard or any other exact measure, also the use of *receivers* or *holders* that operate in connexion with the sliding lathe to receive and firmly hold from slipping, the successive layers of cloth as they are distributed by the folding scales.

"Also the use of a compressible bed or platform on which the cloth is deposited, that operating in connexion with the sliding scales and receivers, shall gradually lower to make room for the cloth as it is folded thereon."

4. For an *Improvement in Ploughs;* Emanuel Albert, East Germantown, Wayne county, Indiana, March 6.

The patentee says,—"The nature of my invention consists in the following arrangement, viz: to have at the upper part of the mould-board and guard-plate, cast solid with the same, flanches in right angle,—the one to the right, the other to the left, in a manner, that when the mould-board and guard-plate are fitted together, the flanch of the one to be covered by the flanch of the other, and permanently fastened together by a screw bolt."

Claim.—"What I claim as my invention, and desire to secure by letters patent, are the two flanches which connect together by the screw bolt permanently the flanch of the mould-board with the flanch of the guard-plate, as described."

5. For an *Improvement in Coal Stoves;* John T. Davy, Troy, Renssalaer county, New York, March 6.

This invention relates to the manner in which the smoke, &c., is conducted from the fire, and the arrangement of the flues incident thereto.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination and arrangement of the flues with the cylinder, so as to take the draft off on each side, directly at the top of the fire, and cause it to descend, thence ascend the corner flues, as described, the stove having an opening in the top for fuel as set forth."

6. For an *Improvement in Planing, Tonguing, Grooving, &c., Plank;* John Cumberland, Mobile, Alabama, March 6.

The patentee says,—"The nature of my invention consists in passing the board or plank to be reduced and planed first under a roller or rollers, whose surface is composed of a series of sharp edges, parallel with the axis, to form cutters, which, in rolling over the board, makes cuts in its surface of the required depth, and at distances apart equal to the spaces between the cutting edges; and then in shaving off the projections thus formed by means of one or more plane irons, leaving the surface smooth, whether these operations be performed by carrying the roller or rollers and plane or planes over the board or plank placed on a permanent platform, or whether this be fixed or connected with a permanent frame and the board or plank be carried to and by them by means of a carriage."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of reducing boards to equal thicknesses, or widths, by passing them under the action of cutting or scoring wheels, which cut into the surface, substantially as herein described, when this is combined with another cutter or cutters, which cuts off the parts scored or indented, substantially as herein described.

"And I also claim in combination with this, a smoothing plane or planes for smoothing or shaving the surface, substantially as herein described. And I wish it to be understood that I claim this method of reducing and planing plank, or boards, &c., whether for planing the surface, tonguing, or grooving, or cutting mouldings."

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7. For an *Improvement in Hanging Carriage Bodies;* John Maxson, De Ruyter, Madison county, New York, March 6.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, arranging the helicle springs that support the carriage horizontally and lengthwise along the bottom of the carriage, when this is employed in combination with the four levers having their arms at right angles, or nearly so, to form the connexion between the springs and carriage body, and frame of the running gear, the whole being constructed and arranged substantially as herein set forth."

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8. For an *Improvement in Cotton Cleaners*; Robert M. Livingston, City of Mobile, Alabama, March 6.

Claim.—"What I claim as my invention and improvement, and for which I desire the exclusive privilege and right, is for the application of any kind of net or open work material, affixed upon arms radiating from a shaft, to act as a beater or beaters, either with or without a fanner, in the cleaning of cotton, &c."

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9. For an *Improvement in Steamboats, and Propellers therefor;* Stephen J. Gold, Cornwall, Litchfield county, Connecticut, March 6.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, the employment of side wheels having their shafts parallel with the line of motion, with narrow short paddles in an oblique position on the periphery of the wheel, and all the radial lines of which are perpendicular to the shaft, constructed substantially as herein set forth, and so arranged as to dip the paddle only into the water, in the manner and for the purpose described, the paddles being made to enter and leave the water without obstruction, and with sufficient velocity to prevent putting it in motion, before leaving it, enough to impede the progress of the boat, as above specified.

"Secondly, I claim placing two or more wheels on the same shaft, constructed as above set forth, the lead or angle of the paddles of the rear wheels being increased as herein described.

"Lastly, I claim forming the wheel with two or more arms, projecting down to the periphery of each of the stationary paddles, said arms being embraced by the paddles, which are made in two parts for that purpose, so as to present no obstruction to their passage through the water, while the strength and lightness of construction are fully preserved, and the paddles are perfectly braced."

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10. For an *Improvement in Horse Powers;* Jesse Urmy, Wilmington, Newcastle county, Delaware, March 6.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is constructing the links of the endless chain of a horse power in the manner described, so that they form firm connexions and a permanent axle for the friction rollers, while at the same time they constitute the rack by which the power is transmitted, substantially as set forth, by which means the use of axles extending through from side to side is dispensed with, while the advantage of the rollers attached to the platform is retained, forming a cheap and efficient horse power."

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11. For an *Improvement in Wheels for Railroad Cars;* Godlove K. Kane, York, York county, Pennsylvania, March 6.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the spokes which unite the hub and rim of railroad car wheels, each of a plate, one portion of which is parallel with the axis of the hub, and extending from the hub to the rim, and the other connected with the rim, in a line diagonal with the plane of the wheel, and extending from the rim to the hub, the first gradually diminishing in width from the hub to the rim, and the other gradually diminishing from the rim to the hub, substantially in the manner and for the purpose described."

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12. For an *Improvement in Cutting Corks;* Philip C. Traver, Newburgh, Orange county, New York, March 6.

The patentee says,—"The nature of my invention consists in cutting corks in the form of a frustrum of a cone, or cylinder, from a sheet of cork (fed by hand or machinery) by means of a cutter fastened to the periphery of a hollow mandrel having a compound longitudinal and rotary motion around a centre or axis of a cylindrical sliding holder, inserted into a corresponding aperture in the mandrel, and bearing upon the sheet of cork, in which hollow mandrel is placed a spiral spring. bearing against the upper end of the holder, the lower end of the holder, guiding the cutter at the required angle to give the required taper to the cork."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the before-described mode of cutting corks, by means of the aforesaid combination of the hollow mandrel, sliding holder, centerer, and guide—with the cutter for cutting the cork to the required shape—said cutter having a simultaneous, longitudinal, and revolving motion produced by the means described, or other more suitable means, operating substantially in the manner set forth."

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13. For an *Improvement in Refining Pine Oil or Spirits of Turpentine;* Norris L. Martin, Brooklyn, New York, March 13.

Claim.—"I claim refining spirits of turpentine or pine oil, by the use of alkali and water, substantially in the manner set forth."

14. For an *Improvement in Weaving Wire for Screens, &c.;* Henry Jenkins, Pottsville, Schuylkill county, Pennsylvania, March 6.

Claim.—"I claim as my invention, the apparatus described for weaving the screens from wire so crinkled; said weaving apparatus consisting in the combination of the stretching frame, or blocks, and screws, with the sliding frame, the harness and the sleigh which are attached to the said frame, the whole of which are made to advance from one end to the other of the loom, by means of the lever and its appendages."

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15. For an *Improvement in the manufacture of Screens or Sieves;* Henry Jenkins, Pottsville, Schuylkill county, Pennsylvania, March 6.

Claim.—"What I claim therefore as constituting my invention, and desire to secure by letters patent, is the manufacture of screens, or sieves, from wire of the larger sizes, either rolled or drawn; the wire from which they are made being prepared by crinkling, as set forth, previously to its being formed into meshes, by which procedure I am enabled to manufacture screens with meshes of the largest sizes, say four inches on the side, more or less, and in such manner as that they shall be more durable, and less costly, than those made in the other ways; and this new manufacture of sieves I claim independently of the particular manner of effecting the crinkling, or of interweaving the wire so as to form the requisite meshes."

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16. For an *Improvement in the Steam Cotton Press;* P. G. Gardiner, City of New York, March 13 (antedated 13 January).

The patentee says,—"The nature of my invention consists principally in the combination of the platten with the piston rod of a vertical steam cylinder, by means of double toggle-joint levers, and connecting rods, in the manner set forth."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the connecting of the platten with the piston rod through the medium of the toggle-joint levers and the suspension rods; arranged, combined, and operating with each other, and with the wings in such a manner as to bring the reaction of the levers principally upon the cylinder, and the bed piece, substantially as set forth."

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17. For an *Improvement in Cleaning Cotton;* Rozell Needham, Memphis, Shelly county, Tennessee, March 13 (antedated December 21, 1846).

Claim.—"What I claim as new, and desire to secure by letters patent, is the combination of the adjustable hatchel and the skeleton cylinder with each other, and with the rotating beating wings and adjustable open concaves, substantially in the manner and for the purpose set forth."

18. For an *Improvement in Rack Wrenches;* Zelotus W. Avery (assignor of Benjamin Webb), New Berlin, Chenango county, New York, March 13.

The patentee declares,—"The nature of his invention and improvement to consist in forming the wrench with a cylindrical chamber in its largest end, extending entirely through it, having a circular seat formed around the same for the reception of a number of cylindrical revolving notched cores or nuts of uniform diameter, fitted to said circular seat, having a square or polygonal opening, in the centre of the same, corresponding with the size or shape of the nut or head of the screw to be turned, which is received into said square, or polygonal opening—the said nut being made to turn with the wrench when turned to the left, by means of a pall, attached to the wrench by a pin and spring, and engaged with a tooth of the nut—said pall, when the wrench is turned to the right, slipping back over one or more teeth of the nut without turning it, and being again engaged with another tooth of the nut, and the wrench again moved to the left, causing the nut to turn with it, and to turn the screw to which the nut is applied, and thus by a repetition of the aforesaid operation, causing the screw to turn as many times as may be required without disengaging the wrench therefrom, by simply moving the handle to the right and left in the arc of a circle, vertically, or horizontally, or obliquely, to any degree required, being adapted to the turning of any sized screw, by merely changing the cylindrical nut or core, without changing the wrench circle, and handle, and its appendages—the revolving notched nut or core being held down upon its seat in the circular chamber of the wrench, by a turning catch attached to the wrench and made to overlap the rim of the core or nut."

Claim.—"I claim as my invention, the peculiar mode or manner of adapting the wrench to the turning of screws, bolts, or nuts, or other articles, made with square, polygonal, or other shaped heads, by means of the changable cores, constructed as above set forth, and represented, in combination with the turning catch for holding the revolving core to its seat, as constructed and operated, as above described."

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19. For an *Improvement in Breaking and Cleaning Hemp;* F. P. Holcomb, New Castle, Delaware, March 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent is, the combination of the stationary bed brake and the rotary brake, and small scutchers arranged in the manner described, so that the hemp can be fed in by hand, broken, and cleaned with but one handling and at one operation, the breaking and cleaning being done on separate cylinders, but the parts so arranged as that they are brought close together, and so adjusted as to only allow the machine to touch that part of the fibre that is to be acted on, thereby preventing its wear in the machine."

20. For an *Improvement in Boring Machines;* Jonathan Johnson, Mifflinburgh, Union county, Pennsylvania, March 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the manner in which I operate and withdraw the auger and regulate the movement of the carriage, by means of the vibrating post and its arms and lateral projecting concave—the cam and pulley, upon the auger shaft—the pin and tooth, upon the pulley—the spring, the detent and pin, connected to each other,—the vibrating bar and weight—the whole arranged, combined, and operating with each other and with the notches in the side of the carriage, and the weight for moving the same substantially in the manner set forth."

21. For an *Improvement in Turning, Cutting, and Splitting Stone;* Charles Wilson, Springfield, Hampden county, Massachusetts, March 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the mode of cutting, turning, or splitting stone, or other like material, by means of a revolving cutter, operating in the manner herein set forth."

22. For an *Improvement in Furnaces for producing Malleable Iron direct from the Ore;* Alexander Dickerson, Newark, Essex county, New Jersey, March 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the method of making malleable iron direct from the ore, by combining a chamber containing the charge with a closed fire containing a continuation of the charge and the loop formed therein, arranged below and communicating with the same, provided with a suitable opening, closed by a door, for the introduction of a portion of the charge, and for excluding the air therefrom; and with movable bars for holding up the charge in the upper chamber whilst burning down the charge in the lower chamber and taking out the loop therefrom at the door, substantially as above described and set forth."

23. For an *Improvement in Air-tight Stoves;* John S. Marll and William J. Ogden, Georgetown, District of Columbia, March 13.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is, the arrangement of the hot air chamber and tubes in combination with the radiating pipes and division plate with its valves, substantially in the manner described."

24. For an *Improvement in the Method of Producing Rectilinear Reciprocating Movements for Planing Machines, &c.;* Moses Ingalls, Burlington, Bradford county, Pennsylvania, March 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the method, substantially as herein described, of giving to the carriage a reciprocating rectilinear motion, in combination with the lateral motion at each end of its course, by means of the straight grooves in combination with the diagonal grooves at each end and the spring switches, substantially as described.

"And I also claim, in combination, the method, substantially as described, of giving the reciprocating motions of any desired extent, and greater than the circumference of the actuating pinion, by placing the two racks on each side of a plain at right angles to the axis of the pinion, in combination with the pinion, having cogs entirely around its circumference in the middle of its length, and segments of cogs on each side as described."

25. For an *Improvement in Cast Iron Plough Clevises;* John Van Brocklin, Middleport, Niagara county, New York, March 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the construction of a double-gaged, cast-iron clevis, substantially as described."

26. For an *Improvement in Clocks;* John S. Greig, Walden, Orange county, New York, March 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the pendulous plate, together with its ball or weight and the cylindrical stud."

27. For an *Improvement in Combing Wool;* C. G. Sargent, Lowell, Middlesex county, Massachusetts, March 13.

We extract the following from the specification:—"The nature of my invention consists in attaching the comb teeth to a series of plates that are caused to slide along in front of the cylinder of cards, and a pair of rollers for the fibres to be acted upon, and stripped from the teeth, and then are shifted in a parallel position to slide back to the end from whence they first started, and there shifted back to pass along as at first; a hollow box through which steam or heated air circulates being placed between the comb teeth and the cylinder of cards, and a little below the points of the comb teeth, for the purpose of keeping the fibres at the required temperature while under operation in the machine."

Claim.—"What I claim, therefore, as my invention, and desire to secure by letters patent, is, making the series of plates that carry the comb teeth continuous in their action by transferring them at each end from one groove or set of ways to another, and back again, substantially as herein described."

28. For an *Improvement in Shirt Bosoms;* Madelin Tassie, Brooklyn, King's county, New York, March 13.

Claim.—"What I claim as my invention and improvement, and desire to secure by letters patent, is, the self-adjusting quality or property the bosom possesses by the addition and application of the yoke and elastic strap described, which belong to no other bosom."

29. For an *Improvement in Looms for Weaving Brussels Carpeting;* Erastus B. Bigelow, Boston, Massachusetts, March 20.

We could not, without drawings, give a clearer idea of these improvements than will be derived from the following claim:

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, giving to the two parts of the mechanism, that which weaves the cloth or forms the body of the fabric, and the one which operates the figuring wires, a separate and distinct organization, substantially as described, when these are connected and combined by an intermediate mechanism which shifts the motive or driving power from one to the other, substantially as described; and in combination with this, I also claim the employment of the two brakes to arrest the momentum of the moving parts to prevent any conflict in the operations of the two parts of the mechanism, as described."

"I also claim the method, substantially as above described, of taking the figuring wires and transferring them one by one to the apparatus which introduces them under the figuring warps, as described.

"And finally, I claim the method, substantially as described, of carrying and dropping the figuring wires under the figuring warps by means of a sliding box or its equivalent which supports the wire, as described."

30. For an *Improvement in Looms;* James Haworth, Frankford, Philadelphia county, Pennsylvania, March 20.

The patentee says:—"My improvement is designed to remove the friction of the shuttle against the "*swett lever,*" and thereby to reduce the power required to operate the loom.

"Beside the aforesaid object, I also, by my improvement, effect another important object, namely, running the loom backward or in a contrary direction, without the use of the shuttle, when the loom is not performing the operation of weaving."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the mode of relieving the pressure of the swett lever against the "*shuttle*" by means of the combination of the additional finger with the *stop-rod* and *lathe-arm* and pin, or any other combination substantially the same."

31. For an *Improvement in Preventing Explosions of Steam Boilers;* Alfred Stillman, City of New York, March 20.

The patentee says:—"The nature of my improvement consists in the use of a tube, one end of which is stopped by fusible metal, and rests upon some part of the boiler liable to be overheated from a deficiency of water, while the other end opens through the external part or shell of the boiler to allow the escape of steam to give alarm to the person in attendance, whenever the fusible metal should become melted by the overheated boiler, and so arranged that the issue of steam may be stopped at pleasure, and the fusible metal subsequently restored to its place with very trifling labor or detention."

Claim.—"What I claim, and desire to secure by letters patent, is, the application to steam boilers of a tube, constructed for the purpose, or in the manner herein described, and stopped with a cap, or any other shaped piece of fusible metal resting upon a part of the boiler liable to become overheated in the absence of a proper supply of water, and designed for the purpose and objects herein substantially set forth."

32. For an *Improvement in Knitting Machines;* Joseph Vickerstaff (assignor of A. Cummings and W. S. Haines), Philadelphia, Pennsylvania, March 20.

The nature of this invention consists in forming the loops from a series of warps, by means of a series of needles arranged in a circle, and parallel with each other, made to slide within a ring, that answers the purpose of a presser, so that the threads which are to form the new loops shall be caught under the beaks of the needles, before they are closed by the presser ring, to allow the previously formed loops to pass over and be cast off; the bobbins and guides being made to travel around the needles, or to vibrate back and forth alternately, according to the design of the figure to be produced.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the arrangement of the needles in a circle, and parallel with each other, or nearly so, in combination with the pressure ring, by means of which the beaks of the needles are closed to hold the new, and cast off the previously formed loops, substantially as described; and this I claim in combination with the inner tube over which the woven fabric hangs, as herein described.

"I finally claim the rotary table which carries the warps and guides, in combination with the needles, arranged as described, whereby the warps can be carried around continuously in one direction, or alternately in opposite directions, for the purpose and in the manner, substantially as described."

33. For an *Improvement in Steam Engines;* Wilson Eddy (assignor of S. Norris), Springfield, Massachusetts, March 20.

Claim.—"What I claim as new, and desire to secure by letters patent, is, the combining together of two cylinders, an exterior and an interior, as herein set forth; the exterior cylinder being permanently attached to the engine in the ordinary way, and the interior cylinder being removable at pleasure, as herein fully made known."

34. For an *Improvement in Cut-off for Steam Engines;* Horatio Allen, City of New York, March 20.

Claim.—"What I claim in this improvement, is, placing the *fulcrum* of the lever, which carries the cut-off slides, *on the rod* carrying the main valve, or on some part having the same motion as the main valve, substantially in the manner set forth."

35. For an *Improvement in Steam Valves;* Henry H. Grame, City of New York, March 20.

The patentee says:—"The nature of my invention consists in the introduction of independent valves in the ordinary 'steam chest for sliding valves,' with means of connecting or disconnecting them to the slide valve, operating, when connected, in such a way as to prevent any further ingress of steam within the cylinder after the piston has passed through a certain part of its stroke, and when disconnected, allowing the steam to work through the whole stroke of the piston."

Claim.—What I claim as my invention, and desire to secure by letters patent, is, the peculiar manner of connecting and combining the cut-off valves with the main valve, the hooks, rockers, and the stops; the said several parts being contained within the steam chest and worked by the main valve, operating and combined in the manner and for the purpose set forth."

36. For an *Improvement in Journal Boxes;* James Old, Pittsburg, Pennsylvania, March 20.

Claim.—"What I claim as my invention, and wish to secure by letters patent, is, the making of a frame, shell, or concave (for confining metals or alloys), by itself, separate from the box for journals of shafts in machinery, and using the same for lining the box, by fastening it in some way thereto, so that the same may be applied to every kind or shape of a box, whether of brads, iron, wood, or anything else, and on or to plain surfaces; and so that when it is worn out, it can be replaced thereon or thereto almost indefinitely by a new one, thereby causing a vast saving in the number and cost of boxes."

37. For an *Improvement in Heating Ovens;* P. Grouville, L. U. Mouchet and E. Mouchet (assignees of B. Rodrigues), France, March 20.

The inventor says, in his specification:—"The nature of my invention consists in the employment of air as a vehicle to convey caloric to the oven from an air chamber heated by furnaces, so that the same air circulates from the air heating chamber, under and through the oven, and when it has been partly condensed and its specific gravity increased, by giving out its contained caloric, returns back, through another set of flues to the air heating chamber, there to be reheated, thus keeping up a constant circulation, from the air heating chamber, around, and through the oven, and back again to the air heating chamber, instead of heating ovens by the circulation of air heated on its passage through a heated chamber, around the oven, or through it, and then escaping into the atmosphere. And also in combining with the above mode of heating ovens, an arrangement of fire chambers without grates and ash pits, and with an arrangement of flues and dampers for heating the air, and to assist in heating the oven, on the principle of returning the products of combustion to the fire chamber, that is fire chambers, flues, and dampers, so arranged that the products of combustion, by the closing of the dampers, are returned to the fire chambers to consume the combustible gases, &c., and to retain the heat within the furnaces and flues, except when an active combustion may be required. And also in so arranging the flues through which the smoke and other products of combustion pass as to increase the temperature of the air as it circulates through a series of passages, under the bottom of the oven to heat it, and thus increase its rarefaction, and cause it to ascend into the oven."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is, the method described of heating ovens by the circulation of air through them from a heating chamber, combined with the oven by two sets of flues, one for the ascending current or currents, and the other for the descending current or currents, by means of which the air, after being heated, passes up through the oven, and becoming specifically heavier, than the ascending current or currents, by giving out a portion of its caloric, descends to the heating chamber to be again heated, and then again to pass up to, and through the oven, and so on; the hot air or heating chamber not being provided with any aperture for the admission of fresh air to it whilst in operation. And I also claim, in combination with the above mode of heating ovens, by the circulation of heated air through the oven, the arrangement of furnaces, flues, and dampers, as herein described, operating on the principle of the air-tight stove, by means of which combination, the desired temperature can be maintained within the oven at a small expenditure of fuel, whilst the apparatus possesses the capacity to attain the temperature required, as described. And we also claim arranging the main and return flues for the passage of the smoke and other products of combustion directly under the chamber through which the heated air circulates to heat the bottom of the oven, by means of which the rarefaction of the hot air is increased, to cause it to ascend into the oven, as herein described."

38. For an *Improvement in Foot Stoves;* George H. Thatcher, Ballston, New York, March 20.

Claim.—"What I claim, is the peculiar construction of the apparatus for surrounding the feet with a thin stratum of heated water, as above described. And I claim in combination therewith, the adjustable heater, arranged and operated in the manner and for the purpose set forth."

39. For an *Improvement in Pumps;* Ralph Bulkley, City of New York, March 20.

The patentee says,—"The nature of my invention consists in the application to, and combination with, vessels' stepped pumps, a vertically applied indentation or indentations, on the *outer* surface of the pump, extending upwards from or near the lower end of the pump, to any required distance, about four or five feet, upwards, more or less. These indentations may be made by fluting, or by grooves, or by battons placed at suitable intervals; and these indentations may extend entirely around the pump, or around any required section of it. And *through the projections* so formed by fluting, grooving or by battons, *transverse indentations*, or orifices are to be made, sufficient to form a *communication* for water from *each* indentation to the others; and one or more of the *vertical* indentations are to extend to and communicate with, the *lower* or receiving *orifice of the pump;* and those *not* so communicating, are to have a *stop-water* at foot; leaving only the horizontal or transverse communications open; around these transverse fluted indentations, downward, in sections, or entire, including the main orifice, is to be applied, appended thereto, a metallic, or other covering, containing small *perforations*, so that water may pass through into the indentations on the outer surface of the pump, to the receiving orifice ; so that if the *covering* at the lower end of the pump should become "choked" or clogged by swelled grain, or otherwise, the *water* would rise upon the pump, until it found an *entrance* into the indentations or transverse flutes; and in the outer canals formed thereby, the water will pass *downwards* unobstructed, into the receiving orifice of the pump; the object of which is, to preserve an *unobstructed* passage for water to the orifice of the pump, though the lower *end* and *lower part* of the pump become "*choked*" and *clogged* with swelled grain or otherwise; a casualty of common occurrence, arising from a *variety of causes*, by which the pumps frequently, at times most needed, become *useless*, endangering life and property."

Claim.—"What I claim as my invention, and desire to secure by letters, is the application to, and combination with, vessels' pumps, the indentations and appendages connected therewith, as herein described, for the objects and purposes herein set forth, using, therefore, any description of material that will effect the object."

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40. For an *Improvement in Screening Grain;* John Bamborough, Lancaster, Pennsylvania, March 20.

The patentee says,—"The nature of my invention consists in the construction and arrangement of the screens for screening the grain from cockle, &c., and conveying it off separate from the grain, while it is susceptible of being converted into the common riddle fan at pleasure."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the screens and cockle boards, arranged substantially in the manner and for the purpose set forth."

41. For an *Improvement in the Expansion Joint for Steam Engines;* Henry R. Dunham, New York, March 20.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of a plate of flexible metal in a steam pipe between two flanches of different diameters, the yielding of which plate shall give sufficient room for the expansion of the pipe, thereby avoiding the necessity of using stuffing boxes, or the ordinary copper hemispherical ring joint, for side pipes of steam engines."

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42. For an *Improvement in Looms;* Lawrence Holmes, Anderson, Essex county, Massachusetts, March 27.

Claim.—"What I claim as my invention, is the peculiar manner of producing, by means of the jacquard apparatus, a double draught upon each of the harnesses; in other words, I claim the peculiar punches and bars (connected with the harnesses as described) as combined together, and with the remainder of the jacquard apparatus and with the harness, and constructed and operating therewith, substantially as described."

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43. For an *Improvement in Carriages;* A. W. Forward, Georgetown, Kentucky, March 27.

Claim.—"The improvement which I claim, and for which I desire letters patent, is the converting of a two horse carriage into a one horse carriage, by separating the fuchels, and the branch stays, which is done by removing the four bolts described."

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44. For an *Improvement in Furnace Bars;* John H. Fellows, Cincinnati, Ohio, March 27.

The patentee says,—"The nature of my invention consists in an improved furnace bar as follows, viz: first, the common bar is generally made flat on the surface, but the present invention has two longitudinal grooves, and a raised centre ridge between them. The grooves fill with ashes from the fire of either coals or wood, as the case may be, which being a nonconductor of heat, keeps the bar from melting, while the raised centre ridge must always keep the same cool. Second, the raised centre ridge always prevents the possibility of drawing the ashes out from the grooves in the bar, when clearing the fire with the poker, which is requisite to keep the space between the bars from filling up with clinkers, and thereby stopping the draught; hence, the ashes always remaining in the grooves, protected by the centre ridge, keep the middle of the bar cool. It cannot therefore warp or get out of its place, like the old bars. Third, in putting out the fires of either steam boats or land furnaces, which is desirable when the engine stops, to save fuel, and the time of the hands—bars frequently break down as soon as cold water is thrown on the fire—not so with the present invention; cold water thrown on them makes the bed of ashes firmer in the grooves, and the bars are not injured by being suddenly cooled, like the common ones. Fourth, the bars now in general use are made double, so that when hot, should one side give way the other must follow. This is avoided by the present invention, being a single bar which also gives a further advantage, as they can be placed at any given distance from each other, so that by widening the space, give an additional draught, which is desirable, and more particularly with low furnaces."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of two grooves and a central ridge to furnace bars, in the manner described above."

45. For an *Improvement in Augers;* Alfred Newton, L. B. Smith, and E. Sanford, Meriden, N. Haven county, Connecticut, March 27.

Claim.—"What we claim as our improvement and invention, and desire to secure by letters patent, is the making or constructing double or single twist augers, with a gradually increasing length of twist, and consequent gradual enlargement of cavity, from the lower or cutting end to the other extremity of the twist."

46. For an *Improvement in Pneumatic Hydraulic Engines;* Joseph C. Strode, East Bradford Township, Chester county, Pennsylvania, March 27.

We are informed by the patentee,—"The nature of this invention and improvement consists in making use of a column of condensed air between the propelling fluid, and the fluid that is to be raised—said air being condensed in a pyramidal shaped chamber, by means of the momentum of a descending column of water—said chamber having a communication by a small opening at its top with another chamber into which the spring water, or fluid to be raised, is introduced, called the spring water chamber, and upon which the condensed air in the first named chamber is made to act, causing said fluid to rise through a tube placed in the spring water chamber, (open at its lower end, and closed alternately at its upper end, by means of a valve,) into a large air vessel, or receiver, of the usual form and construction, being conducted thence to its place of destination, by pipes or hose, in the usual manner."

Claim.—"What I claim as my invention, and wish to secure by letters patent, is, first, making use of a column of condensed air between the propelling fluid—and the fluid to be raised in the manner above described, or other mode substantially the same by which analogous results are effected. Second, I claim the particular combination of the pyramidal air chamber, the internal spring water chamber, and the water tube with the curved conducting pipe and valve, and the air chamber and hinged valve, constructed and arranged in the manner and for the purpose substantially as set forth."

47. For an *Improvement in Bobbin Stands;* Noah C. Piram, Boston, Massachusetts, March 27.

The patentee says in his specification,—"My improvement in said stand consists in combining with it, and also with the cap piece, vertical lips or flanches, one of which is made to extend entirely around the lower head of the bobbin, and to rise up above the lower surface of the said head. The other flanch in a similar manner extends downwards from the cap plate, and around the upper head of the bobbin, and below the upper surface of the said head. The object of the said flanches is to prevent the twine on the bobbins from either passing between the lower surface of the lower head of the bobbin, and the upper surface of the base, or between the upper surface of the upper head of the bobbin, and the lower surface of the cap piece, as it very often does in the ordinary bobbin stand, and by so doing either becomes entangled, or so wedged between the surfaces in opposition, as to render it nearly, if not entirely impossible to rotate the bobbin, until the cause of the difficulty is removed."

Claim.—"What I claim, is the lip or flanch as applied to, or combined with, the base or cap piece, and arranged with respect to the bobbin, in the manner and for the purpose as above specified."

48. For an *Improvement in Steam Engines;* Charles Galvani (assignor of John Clark), City of New York, March 27.

The patentee says:—"The nature of my invention consists in combining a rotary engine with an annular furnace, the revolving rim of the engine being heated so that when water is forced into it, it shall be flashed into steam which passes round through the cylinder and thence issues through an orifice on one side at a tangent to the wheel."

Claim.—"What I claim as new, and desire to secure by letters patent, is, the combination of the engine, constructed substantially as described, with a furnace in which it revolves, and which generates the steam with which it is driven, all as above set forth, by which what is denominated flash steam is employed in a rotary engine."

49. For an *Improvement in the Steam Cross Cut Saw;* Lewis Kirk, Reading, Berks county, Pennsylvania, March 27.

The nature of this invention consists in attaching a cross cut saw to the cross head of a steam engine, hung on trunnions, in a frame, the ways on which the cross head slides being attached to the head of the cylinder, and the same passing through a guide at the end of the ways, so that by this arrangement the saw is operated directly by the piston rod, and is at liberty to move down through the log as it cuts, in consequence of having the engine hung on trunnions. My invention also consists in reversing the direction of the steam ways that connect the steam chest with the ends of the cylinder, in combination with the two tappets on the valve rod, which are struck by the cross head to shift the valve towards the end of each stroke, by means of which arrangement I am enabled to dispense with the rock shaft heretofore employed in all engines which operate the valves by the direct reciprocating motion of the piston. And, finally, my invention consists in coupling the trunnions of the cylinder (which are hollow for the introduction and escape of the steam) with the steam and exhaust pipes, by having a cylindrical fillet on the end of each trunnion fitted to an annular cylindrical groove in the end of the steam and exhaust pipe, so that by putting packing in this groove, it can be forced up against the end of the fillet to make a steam-tight turning joint by means of coupling screws which pass through the flanch of the pipe, and a collar that turns on a groove cut in that part of the periphery of the trunnion which projects beyond the boxes in which it turns."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, combining with a steam engine, that is hung on trunnions to admit of its vibration as herein described, a cross cut saw attached to the cross head of the piston rod, as described, whereby the saw can receive its longitudinal motions to cut an up and down motion to pass through the log as it is cut, and to be lifted up preparatory to another cut, substantially as described."

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50. For an *Improvement in Reducing and Bleaching Straw and other Fibrous Substances;* Lemuel W. Wright (citizen of the United States, residing in London), March 27.

The patentee says:—"These improvements consist, firstly, in the novel arrangement and construction of the several parts of the machinery or apparatus employed, and in the application of the same to the process of reducing and bleaching straw and other fibrous substances (such as wheat, oat, rye, barley, or rice straw, wood, and jute weed, commonly called larat, as well as various kinds of grass and Indian corn, leaves and husks, &c.), to be used for the manufacture of various kinds of paper, mill board, card board, button board, &c.; secondly, in the particular machinery or apparatus for cleaning and washing all the dirty and extraneous matter from the straw or other fibrous substances. Thirdly, in the peculiar adaptation of the machinery or apparatus used or employed for reducing or grinding the same into a state of pulp by means of heavy rollers revolving on a plate. Fourthly, in the continuation of the washing of the fibrous substance in the pulpy state, and in the peculiar apparatus or machinery employed for the purpose of boiling the same by steam. And fifthly, in the machinery or apparatus for washing the pulp from the boiling process for performing the souring and chloride processes, and thus perfecting the operation of bleaching the pulp ready for use, as hereinafter described."

Claim.—What I claim as my invention, is the combination and arrangement of the respective parts of the apparatus, as described, by which the straw or other material is subjected in succession to the boiling, washing, and bleaching processes, the respective vessels, the tubes for the conveyance of water and steam and for the transference of the material, and the apparatus for reducing it to pulp, being arranged and operating substantially as herein set forth, by which means the complete preparation of the paper pulp is effected more economically than heretofore. I likewise claim the construction of the apparatus for converting the pulp into paper, or mill board; said apparatus consisting of a water tight box, and of a deep frame the movable bottom of which constitutes the paper mould; said box, frame, and mould being in the arrangement of the parts and its operation, such as is herein described and represented."

51. For an *Improvement in Ditching and Fencing,* Elhanan W. Thomas, Chicago, Illinois, March 27.

Claim.—"What I claim as my invention, and wish to secure by letters patent, is the combination of two ditching machines in the manner described, so that the sods cut from two parallel ditches shall be elevated and placed with the grass out in a continuous ridge between said ditches at one operation, in the manner and for the purpose set forth."

52. For an *Improvement in Raising Water on Bars, Shoals, &c., for rendering them Navigable;* Waller Harris, Richmond county, Georgia, March 27.

"The nature of my invention," says the patentee, "consists in concentrating the water on the channel of streams when at or near low water mark, or below navigable point, by means of fixtures extending from one or both edges of the stream, according to circumstances, and rendering them navigable."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the method of obtaining a line at right angles to the current of a stream, for the erection of eddies, piers, or other fixtures, employed in deepening streams, by means of the floating apparatus, provided with shafts and turning on the post, in the manner described."

MECHANICS, PHYSICS, AND CHEMISTRY.

Abstract of a Lecture on the Decomposition of Salts by Hot Steam. Delivered before the Pharmaceutical Society, London, February 9, 1848. By Professor E. Solly, F. R. S., F. G. S., &c.

That steam possesses considerable powers in effecting the decomposition of many substances has long been known; but the extent of these powers, the mode in which they act, and the effects to which they give rise in nature, are very little known: it was the object of this lecture to draw attention to this kind of decomposition, and to illustrate some very curious phenomena produced by it.

In introducing the subject, the Lecturer briefly adverted to the mode in which chemical affinity acts, and the two great changes, of combination and decomposition, to which it gives rise; the latter taking place when some antagonist or interfering cause neutralizes or overcomes the force of chemical affinity; the most important of these causes were the following:—

1. *Superior affinity;* the commonest cause of decomposition, being either simple, when one substance separates two others, because it has a superior affinity for one of them, as where potassium decomposes water by abstracting its oxygen; or double, when two binary compounds mutually decompose each other, and form two entirely new substances.

2. *Spontaneous change,* or a tendency of compound substances to separate into their component parts; an effect in many cases produced by the mere re-arrangement of the elementary particles into simpler, and more stable compounds.

3. *Mechanical attraction.*—Chemical action, it is well known, is often checked and controlled by the mere force of aggregation; in some cases it appears to be even overcome by that power; thus strong solutions of the alkaline silicates are decomposed by sand, or finely divided silica, forming a hard and solid sandstone; in this case the silicate seems to be decomposed in consequence of the aggregative power of the silica.

4. *Heat,* which, like spontaneous change, in many cases produces decomposition by tending to resolve substances into mere simple compounds. In some cases, however, such as oxide of mercury, the decomposition is entire, the substance heated being wholly reduced into its elementary constituents.

5. *Light,* which, like heat, possesses the power of augmenting or diminishing chemical affinity, causing the combination of some substances, such as chlorine and hydrogen; and separating the elements of a number of compounds, such as those of silver, gold, mercury, &c.

6. *Electricity,* which, in passing through a number of compounds, causes their decomposition. All substances which are thus decomposed, appear to consist of simple equivalents of conducting and non-conducting matter: those which consist wholly of non-conducting elements, are entirely non-conductors, a property which likewise belongs to those compounds containing one equivalent of a conductor, united to two or more equivalents of a non-conductor; whilst those which consist of equal proportions of conducting and non-conducting matter are electrolytes or conductors, which undergo decomposition when liquid, but non-conductors when solid.

7. *Example.*—When two distinct compounds, having no action in each other, are mixed, if the one from any cause should undergo decomposition, it will, in many cases, tend to induce the decomposition of the substance with which it is mixed, even though the latter has independently no tendency to change or decompose. Fermentation is of this kind.

8. *Presence.*—Perhaps the most remarkable of all the sources of decomposition, is that kind of influence to which Berzelius, in 1835, gave the name of Catalytic action; a term which, without conveying any theoretical view as to the mode in which these effects are pro-

duced, must be taken as solely indicating those changes in chemical composition merely produced by the presence of certain substances, not undergoing any change themselves, or in any way chemically active in producing the effects observed. The decomposition of oxy-water by the metals, and of fused chlorate of potash by oxides of manganese and copper, are good illustrations of catalytic action. Those who advocate the contact theory of electricity, or believe that the mere contact of dissimilar kinds of matter gives rise to the evolution of electricity, may explain these phenomena on the supposition, that, as the electrical equilibrium of matter is disturbed by the contact of dissimilar matter, so the chemical powers of any substance will be more or less modified by the contact of other substances, even though they have no affinity or tendency to combine with the substance which thus influences them.

The decomposition of a substance is generally not caused by one of these forces alone, but by a combination of two or more of them together, the facility with which they act depending on the strength which binds together the elements of the compound. A very great difference is found to exist between even the same class of compounds: thus potassium and oxygen combine with the greatest facility and under any circumstances, however unfavorable; but are separated with very great difficulty, there being a wide range between the point of combination and that of decomposition. Oxygen and mercury, on the other hand, exhibit comparatively but little attraction for each other, and when combined, a very slight determining cause will produce their separation. In some cases, chemical affinity and the opposing forces are so nearly balanced, that combination or decomposition may be apparently produced at pleasure. The decomposition of steam by hot iron, oxide of iron, and hydrogen being produced, and the decomposition of hot oxide of iron and hydrogen, steam and iron resulting, is a familiar illustration of this balance of power.

In effects of this kind it is obvious some part of the action is produced by *mass*, as distinct even from that due to mere rapidity of action, or perfect mixture. When a solution of sulphuret of potassium or calcium is poured into excess of muriatic acid, a very different effect is produced to that caused by pouring muriatic acid into the sulphuret; in the former case bisulphuretted hydrogen is formed, in the latter sulphuretted hydrogen is evolved, and sulphur deposited.

Berthollet, on studying the nature of decomposition, was led to the conclusion, that when a compound was decomposed by the exertion of superior affinity, the result was not merely in accordance with the ratio of affinity, but depended also on several other conditions, and on the nature of the substances present. When, for example, a strong acid is added to a saline solution, he conceived that the base would not entirely separate from the weaker acid, and combine with the stronger one alone, but that it would be equally divided between the two, in the proportion of their relative mass. He conceived that single or double decomposition was never complete where no change of form took place—that two salts when mixed together would only half decompose each other, unless one of the resulting compounds was insoluble; when this was the case, or in any other way one of the products could be removed, as the remainder of the salts would then be half decomposed, and, as this action would continue with infinite rapidity, the whole of the compound would finally be decomposed.

Subsequent experiments showed, however, that this view was not correct, and that in many cases, Berthollet was misled by the formation of acid or basic salts. Some interesting experiments on this subject were made by Mr. Phillips in 1816 *(Quart. Jour.*, i, 80*)* showing the mutual action of carbonate of potash on sulphate of baryta, and carbonate of baryta on sulphate of potash. There are, however, many points connected with the decomposition of salts, requiring further investigation.

For more than fifty years it has been known, that under certain circumstances, steam possesses considerable power in aiding the decomposition of many compounds. This has, for the most part, been either attributed to superior affinity, or to mere mechanical action—it has not been recognised as a distinct and definite mode of decomposition, and, consequently, the recent experiments of Mr. R. A. Tilghman, whilst they unite a number of known phenomena under one general head, and exhibit a series of new and unexpected decompositions, show that the force which produces them is one of very high and peculiar power.

Mr. Tilghman has found that a large number of salts, including some of the most fixed and stable compounds known are readily decomposed by a current of steam, at a high temperature. It appears essential to this action, that the acid itself should be either volatile or decomposable at a high temperature, and the action is probably facilitated by any affinity which the base may have for water, the tendency to form a hydrate assisting in the expulsion of the acid. The temperature and other conditions requisite for this effect vary with different salts, depending on various circumstances, such as the affinity to be overcome, &c. In many cases also, decomposition is masked, or even wholly prevented, by interfering circumstances; yet these present no exception to the general rule, for it may readily be shown that decomposition takes place as soon as these interfering causes are removed.—*Amer. Phil. Trans.* x. 167.

The interesting experiments of Gay Lussac and Thenard, which arise out of their investigations into the nature of chlorine and muriatic acid, showed many remarkable instances of decomposition under the agency of steam. When, for example, dry chlorides were treated with dry boracic acid, they were not decomposed, though they were readily acted on when exposed to the influence of steam. This, it was at first supposed, depended on the fact that the acid could not exist in the dry state, but afterwards was shown to result from the want of oxygen to combine with the metal of the chloride, and form an oxide which could unite with the boracic acid.

These experiments, and the consideration they give rise to, were of considerable practical interest in connexion with lime burning, for it was shown that carbonate of lime is far more easily decomposed when heated in steam than in dry air, and on the other hand, that hydrate of lime is readily converted into carbonate when heated in carbonic acid, bearing out the well-known fact that damp chalk or limestone is easier converted into quick lime than it is when quite dry. This action of water has been variously explained. Dumas regards it as either caused by the superior affinity of lime for water at a high temperature, which causes it to combine with the latter and set free the carbonic acid, or else that the steam being partially decomposed by the ignited fuel in the lime kiln, generates a portion of hydro-carbon, which decomposes the carbonic acid of the limestone, reducing it to the state of carbonic oxide (*Traité* ii, 247). Gay Lussac considers that the first explanation is inadmissable, because hydrate of lime is quite as easily decomposed by heat as carbonate, and shows the incorrectness of the second explanation by some excellent experiments, in which decomposition is shown to be wholly caused by the steam, quite independently of the products of combustion.—(*Ann. de Ch. et de Phys.* lxiii, 219).

Although it is perfectly true, that under similar circumstances, the carbonate and hydrate of lime are decomposed with equal facility by heat, yet it is also evident that the affinities are so nearly balanced, that some influence may be reasonably attributed to mass, and that the affinity of lime for water would be rather greater than for carbonic acid when the former was present in large excess. Another very important consideration is, the facility of diffusion. The mere mechanical effect of diffusion would facilitate the decomposition of carbonate in an atmosphere of steam, or hydrate in an atmosphere of carbonic acid. The conclusion drawn by Gay Lussac from his experiments, was, that the influence of steam in assisting the decomposition of the carbonates, was due to the increased facility given for the diffusion or escape of the carbonic acid.

The most important compounds which Mr. Tilghman has decomposed by the influence of hot steam are the earthy and alkaline chlorides, fluorides, sulphates, silicates, borates, phosphates, and chromates. Two interfering effects require to be guarded against in experiments of this sort, namely, the fusibility or volatility of the base when set free; those compounds which are fusible, or the base of which is fusible, are of course more difficult to decompose than others, as becoming superficially fused they are then for the most part protected from further action. On the other hand, when the base is as volatile as the acid, the two though separated by the steam, reunite to form the original compound nearly as rapidly as they are separated.

The decomposition of such substances by steam, is very greatly facilitated by the admixture of some infusible inert porous substance, which shall act as a retainer, mechanically preventing loss by evaporation or fusion.

Common salt, sulphate of soda, sulphate of baryta, &c., may be partially decomposed by steam alone, when sufficiently heated, but the interfering causes just mentioned, prevent more than a small portion from being decomposed; by the use of retaining substances, however, they may be rapidly decomposed to a very considerable amount, muriatic acid, or sulphuric acid mixed with sulphurous acid and oxygen, being given off, whilst caustic soda or baryta remains.

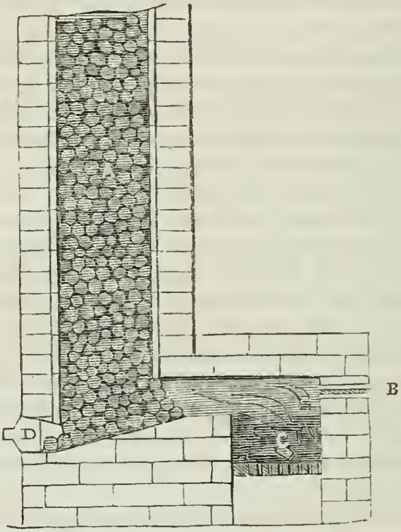
Several different theories, or modes of explaining this action, naturally suggest themselves; amongst these are, superior affinity, diffusion, and catalytic action. It is evident that in all feeble combinations, and especially those where both acid and base have a tendency to form hydrates, the affinity of the acid and base for each other may be weakened by heat, whilst that of both to form hydrates may not, or may be, proportionably less weakened. It is evident that in the case of all haloid salts, the presence of water must be essential to their decomposition by heat, whether alone or in the presence of another acid, as a source of oxygen to the metal, and hydrogen to the chlorine; and it is plain that, in most cases the separation of an oxide from muriatic acid, must be far more easy than that of a metal from chlorine. This action of water does not apply to the decomposition of other salts, unless we adopt the view of the composition of salts first advanced about 1815, by Davy, and afterwards brought forward by Dulong and others, according to which all salts are assumed to be formed on a similar type, the salts of the oxy acids being considered as consisting of the metals united to the acids + oxygen: thus chloride of sodium being Na, C, sulphate of soda would be Na. So_4. Perhaps the strongest argument in favor of this hypothesis is the manner in which it explains the relation of acid to the oxygen in salts of sesqui or deutoxides. There are, however, serious objections in the number of hypothetical substances the existence of which must be assumed, and in the fact that two distinct bases must be assumed to explain the composition of bi-salts.

There can be little doubt that in several cases these decompositions are materially facilitated by the freedom with which the substances evolved are carried away by diffusion. It is, however, hardly possible to conceive that these effects are wholly caused in this manner; because, if they were, dry air should be expected to produce some effect in decomposing salts like the sulphates, which, however, appears not to be the case; and further, in some cases, the substance evolved has no tendency to diffuse, being at once decomposed, like chromic acid, which is readily evolved from its compounds with the alkalies, at a high temperature by steam, though at once resolved into oxide of chromium and oxygen.

In some respects the process of decomposition by steam approaches more nearly to the effects of catalytic action than to those of any other known mode of decomposition; at all events, though it may not be clear that they depend on the same power, yet it is evident that no other explanation can be considered as altogether comprehending the phenomena in question.

Independently of the scientific interest of these experiments, in connexion with the laws of affinity and decomposition, they possess great value in a practical point of view, both as indicating new processes of manufacture, and as explaining the nature of many geological phenomena which are of practical importance in the arts.

One of the most remarkable of the new manufacturing processes, and for which Mr. Tilghman has obtained a patent, is the direct decomposition of soda salts, and especially common salt. The experiments of Gay Lussac and Thenard, as well as others, have long since shown that common salt may be decomposed by the action of various substances, particularly silex, when exposed to the influence of steam at a high temperature; but these cases appear to have been merely considered as decompositions by superior affinity or substitution, the result being only the conversion of common salt into some oxygen salt, in which the soda is strongly combined to an acid, from which it can only be obtained by a new process. In Mr. Tilghman's mode of working, common salt is mixed with some porous retaining substance, such as alumina, phosphate of lime, &c., decomposed by steam at a high heat, and the product simply lixiviated, when it *at once* yields a strongly alkaline lye. It must be borne in mind, that the retaining substances do not act merely by chemical affinity, but that their action is chiefly mechanical; this constitutes an important distinction between this and all other processes, and, as a necessary result, the soda obtained is nearly pure, and requires very little further manipulation.



The decomposition of salt in this mode, may easily be carried on continuously in a kiln, like lime-burning, balls of a mixture of salt and alumina being thrown in above, and withdrawn from the furnace below, when the operation is judged complete. The accompanying wood-cut represents the kind of kiln which has hitherto been employed, though there is little doubt that it will soon be modified and improved. C is the fire fed with coal or coke; A the kiln through which the whole products of combustion pass; the salt balls are thrown in above, and withdrawn from time to time at the discharge door D; B, the steam pipes through which a constant current of hot steam is allowed to pass over the ignited fuel, thus insuring a uniformly damp atmosphere in the body of the kiln.

The passage of the results of combustion through the kiln does not in any way interfere with or modify the decomposition of the salt; various practical precautions must be attended to, a certain temperature and a certain proportion of steam being found most advantageous. Under favorable circumstances, eighty per cent. of the salt employed has been decomposed and converted into caustic soda and muriatic acid.

When alumina is the retaining substance used, the solution of alkali obtained holds a large quantity of that earth in solution, in a very convenient form for the use of the dyer, being readily separated by mere exposure to the air, or even by the action of some coloring matters. When carbonate of soda is to be prepared, the solution may be readily carbonated by a current of carbonic acid which precipitates the alumina, or the furnace balls may be crushed and carbonated, *per se;* on lixiviation they then yield pure carbonate of soda, and the whole of the alumina remains insoluble ready to be employed over and over again in aiding the process of decomposition. For some purposes the presence of a small quantity of alumina in solution does not do any harm : thus, for example, the crude alkaline solution may be at once employed for the manufacture of soap.

Perfectly similar processes may be used to effect the decomposition of salts of baryta and strontia ; but with these a somewhat higher heat than that required for the fixed alkaline salts is necessary, the fusibility of the results may be obviated by the use of porous retaining substances such as lime, and the operation may be conducted continuously in a kiln or reverberatory furnace.

In the decompositions of the sulphates a part of the acid passes off pure, the remainder being in turn decomposed by the heat into sulphurous acid and oxygen ; it is probable that sulphuric acid might be economically made from a cheap sulphate, such as gypsum, by this process, as far less extensive or costly apparatus would be required than in the ordinary mode of manufacturing it from sulphur and pyrites.

The separation of other acids from bases, such as hydrofluoric, may also probably be practically employed with advantage. The decomposition of salts of the fixed acids, such as silica and boracic, though now more interesting as abstract facts, is probably less likely to lead to practical results. In these cases the volatilization of the fixed acids is assisted by the steam, in the same way that the distillation of oils, &c., is aided by steam: the fact that ignited silica is volatile in a current of steam has been known some time, from the interesting experiments of Jeffries, an account of which was read before the Royal Society in 1840, but not published in the Philosophical Transactions, *(Phil. Mag.* 1840, xvii. 299.*)*

It is evident from the foregoing fact, that in every case, when a hydrated salt is rapidly dried, it is liable to be more or less decomposed; this fact is worthy of attention, as the effect thus produced, in some cases, might introduce serious errors into processes of analysis. The tendency of chloride of calcium to undergo partial decomposition, when rapidly dried, has been known for some time. It is also worthy of remark, that as all ordinary flames contain hydrogen, they are more or less moist, and consequently have a certain amount of decomposing power; hence the flame of a lamp, or candle even, is able alone to render many salts distinctly alkaline in a very short time.

In conclusion, Mr. Solly briefly adverted to the important light which these new experiments would probably throw on volcanic and other geological phenomena. Thus, for example, the evolution of boracic acid, in the hot springs of Tuscany, which has been accounted for on the supposition of a bed of sulphuret of boron, existing below the surface of the earth, and gradually undergoing decomposition from the action of water, could be far more simply explained, when it was shown that any salt of boracic acid, such as the borate of lime, is readily decomposed at a red heat by the mere presence of aqueous vapor.

Process for Bronzing different Metals. (*Note of* M. BECQUEREL.)

Translated for the Journal of the Franklin Institute.

MM. Brunel, Bisson, and Gaugain, have requested me to present to the Academy, pieces of different metals bronzed by an electro-chemical process, which has now been applied in the Arts.

M. de Ruolz had already communicated to the Academy in 1841, a process by which he bronzed several metals; that is, he deposited upon them, by the aid of the galvanic battery, layers more or less thin, of brass, or of bronze. This process, which required the use of the alkaline double cyanides of copper and zinc, or of copper and tin, was not adopted in practice, either on account of the high price of the cyanides, or from some other reason.

MM. Brunel, Bisson, and Gaugain, have substituted for the cyanides a solution in water of 500 parts of carbonate of potassa,
20 " chloride of copper,
40 " sulphate of zinc,
250 " nitrate of ammonia.

For bronze, a salt of tin is substituted for the sulphate of zinc.

By means of this solution, cast and wrought iron, steel, lead, zinc, tin, and the alloys of these metals either with each other, or with bismuth or antimony, may be easily covered with brass or bronze, after a previous cleaning depending upon the nature of the metal.

The operation is performed cold: the piece to be covered is put into connexion with the negative pole of a Bunsen (carbon) battery, taking for the positive decomposing pole, a plate of brass or of bronze.

When it is desired to cover large surfaces, experiment has shown that the number, and not the size of the couples must be increased.

When the pieces are coated, and have been colored as is usual in the arts, they rival the most beautiful bronzes. A very beautiful appearance may be given to coarse iron castings.

Pieces thus covered do not oxidize in the house. Those which are designed to be placed out of doors, must be varnished as usual. The new process of which I have endeavored to give an idea to the Academy, will be valuable in the arts, and deserves to be encouraged.

Comptes Rendus de l'Academie des Sciences de Paris, March 20, 1848.

Commercial Value of Different Cochineals.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

M. Cheveeul communicated to the Academy of Sciences of Paris, at their meeting on the 27th March, 1848, some very interesting experiments upon the comparative merits of a cochineal, raised in 1845, in Algiers, and the *Zaccatilla* cochineal of commerce, which is the black female insect of Mexico, which has died naturally after the deposit of her eggs. The following are his conclusions:

The cochineal of Algiers has less coloring power than the Zaccatilla, but the difference is less for scarlet than for crimson.

For crimson, the comparative values of the two are as 4 to 5. The cost of the Zaccatilla cochineal, being 19·5 francs per killogramme, the value of the Algerine will be, for crimson, 15·6 francs; but for scarlet, it will be worth 17·15 francs. At a mean about 16·35 francs.

He suggests an inquiry whether the difference of color, (the Algerine being more of an orange hue than the other,) may not be due to the different species of plant upon which the animals are fed; the Mexican insect being fed upon the *Cactus cochenilifer*, the Algerine upon the *Cactus Opuntia*. Ibid.

On the Polarization of Light.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The following are the conclusions from some experiments by M. J. Jamin, upon the polarization of light by reflexion from transparent substances:

1. That there exists no substance which polarizes light completely.
2. A beam polarized rectilinearly is always transformed by reflexion into one polarized elliptically.
3. The difference of phase varies from π to 2π, when the incidence increases from 0° to 90°.
4. The polarization is more complete, and Fresnel's laws more exact, in proportion as the index of refraction of the substance diminishes. Ibid.

Temperatures of the Arctic Ocean.

Translated for the Journal of the Franklin Institute.

The Proceedings of the Academy of Sciences of Paris, for March 13, 1848, contains the following account of a memoir, by M. Ch. Martins, on the temperatures of the Arctic Ocean, at the surface, at great depths, and in the vicinity of the Glaciers of Spitzbergen. The extract is by the author.

"This memoir rests upon 305 observations of temperature, made by MM. Bravais, Pottier, and myself, in the four voyages of *La Recherche*, between Hammerfest, in Lapland, (latitude 70° 40′ North,) and Spitzbergen as far as 79° 34′ N., as well as in the neighborhood of the glaciers of that island, during the summers of 1838 and 1839. The principal results which follow from these observations, are the following:

I.—*Temperature of the Surface of the Sea.*

1. In the middle of summer, the temperature of the Arctic sea, is sensibly equal to that of the air.

2. Nevertheless, as a mean, that of the sea is a little higher, owing to the influence of the Gulfstream, whose extremities are lost upon the western shores of Spitzbergen.

3. The immense glaciers of Spitzbergen, which plunge and crumble into the sea, exercise a very sensible cooling influence upon its surface. The coasts of Norway, where glaciers do not descend to the level of the sea, tend rather to raise its temperature.

II.—*Thermometric Soundings at Great Depths.*

These temperatures are always the mean of the very concordant indications of several Walferdin thermometers, sent simultaneously to the bottom of the sea, and preserved from pressure by a sealed glass tube. The scales which were engraved upon the stems, were arbitrary, and nine divisions corresponded to one degree centigrade. The following are the most important conclusions from these experiments:

1. Between 70° 40′ and 79° 33′ North latitude, and from 7° to 21° 15′ longitude, East of Paris, the temperatures of the Arctic ocean decrease with the depths, during the months of July and August.

2. These temperatures are always above 0°, (32° Fah.,) at least to a depth of 870 metres, (953 yards,) the greatest depth attained in these experiments.

3. Comparing the temperature at the surface with that at the bottom and those intermediate, it appears that the decrease is uniform, at the mean rate of 0·625° per 100 metres, (0·343° Fah. per 100 feet, *nearly*.)

4. The temperature of a liquid layer is more constant in proportion as its depth is greater.

III.—*Temperature of the Sea in the Neighborhood of the Glaciers of Spitzbergen.*

1. In the months of July and August, the temperature of the surface, although very near the freezing point, is always above 0°, (32 F.)

2. From the surface to the depth of 70 metres, (230 feet,) the temperature sometimes increases, sometimes decreases.

3. From the depth of 70 metres, the temperature always decreases with the depth.

4. The decrease of temperature from the surface to the bottom is not uniform; but accelerates with the depth.

5. Between the surface and a depth of 70 metres, it is never below 0°, (32° Fah.)

6. Below the depth of 70 metres, the temperature of the water is below 0°.

7. As a mean, the temperature of this water is, 1·75°, (28·85° Fah.,) and consequently, above that of the maximum density and freezing point of sea water, as determined by M. Despretz.

8. These facts are easily explained, if we remember that the point of maximum density and that of freezing, of salt water, are several degrees below 0°, and if we take into consideration the complex influences, intermitting, and of variable intensity, exercised by the freezing of the surface during winter, the glaciers, the floating ice, the tides and currents."

Account of the Experiments to determine the Principal Laws and Numerical Data, which enter into the Calculation of Steam Engines, by M. V. Regnault.

(Continued from page 361.)

THIRD MEMOIR.

Determination of the Weight of the Litre of Air and of the Density of Mercury.*

In the preceding memoir, the densities of the different gases were determined, referring them to that of air assumed as the unit; but in a great number of circumstances, it is required to know the absolute weight of these gases: this is easily obtained when we know the absolute weight of air under the normal conditions, that is at a temperature of 0°, and under a pressure of 760 mil. of mercury.

The weight of the litre of dry air under the normal conditions was determined by MM. Biot and Arago, with all the care which they could take—they found that at Paris this weight was 1·299541.gr. (*Memoirs of the Academy of Sciences for* 1806. *Biot Traité de Physique, tom.* 1, *p.* 387.) This number has been generally adopted.

But if we reflect upon the imperfections which the theory of gases and vapors still presented at that time, and the great number of uncertain corrections which they were obliged to introduce into their calculations, and if we note that they operated upon air charged with aqueous vapor, for which they endeavored to allow by a correction; and that, in spite of the most minute precautions, this circumstance must necessarily introduce great disturbances into their experiments, we shall understand how absolutely necessary it was to make new determinations of this important doctrine, which will be frequently used in the following investigations.

In the preceding memoir, the weight of dry air which filled the globe at 0°, and under a pressure of 760 mil., was determined with great care; it will be enough then to find the capacity of this globe at 0°, to determine immediately the weight of the litre of air. Now, according to the principle upon which the French system of measures was established, the kilogramme is the weight of a litre of distilled water, freed from air, at the temperature of its maximum density which is about 4° (39·2° *Fah.*); it will suffice then to determine the weight of water at 4° which fills the capacity which the globe presents at 0°.

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* The French litre (the unit of measures of capacity) is 0·2639 of the U. S. standard gallon.

To do this M. Regnault operated in the following way.

The open globe was weighed upon a good balance; its weight was found to be 1258·55 gr. the surrounding temperature being 4·2°, and the height of the barometer reduced to 0°, 757·89 mil.

A small quantity of water was introduced into the globe, and the globe exhausted by means of the air-pump, and at the same time heated. In this way the atmospheric air was completely expelled by means of the vapor of water which was constantly developed. The stop-cock of the globe was then closed.

On the other hand, perfectly pure distilled water was boiled in a large globe to free it completely from the air which it always holds in solution at ordinary temperatures. Upon the tubulure of the first globe was fixed by caoutchouc a glass tube, twice bent, one of whose branches descended to the bottom of the vessel in which the water was kept boiling. On opening the stop-cock of the globe, the boiling water entered it slowly, without coming in contact with air; it was consequently perfectly free from that gas.

The globe being completely filled, the recurved tube was removed, and replaced by a tube having a bulb which was kept filled with the boiling water, and furnished the quantity of water necessary to keep the globe filled as its temperature lowered.

When the globe, filled with water, had come down to the surrounding temperature, it was placed in a zinc vessel, and completely surrounded with melting ice, care being taken to pack the ice in proportion as it melted, upon the walls of the globe.

The globe was left in the ice for a time varying from six to eighteen hours; the stop-cock was then closed, the bulbed tube detached, and the tubulure above the stop-cock carefully wiped.

The globe was placed in a large vessel filled with water at a temperature a little above that of the chamber in which the balance was; it was left for two hours, so that it should take nearly the temperature of the chamber. As the water contracts in proportion as its temperature rises from 0° (to 4°), the globe could be kept closed without danger of breaking. When the globe had acquired the temperature of the chamber, it was weighed, and this weighing (the temperature of the room and the height of the barometer being noted) gives the means of calculating the weight of water at 0°, which fills the capacity which the globe presents at 0°.

According to the experiments of M. Pierre (*Annales de Chimie et de Physique 3d serie, tome* xv, *p.* 348), if the density of water at 0° be taken as 1, at 4° it is $\frac{1}{0{\cdot}999881}$.

Whence we can calculate the weight of the water at 4° (its maximum density), which fills the capacity which the globe presents at 0°. Three experiments give the following results:

I.	9881·060	grains.
II.	9881·113	"
III.	9881·299	"

The third weighing gave a number probably a little too high, because the globe was intentionally left but a little time in the ice, in order to see what influence this circumstance would have upon the result. On this account M. Regnault adopts the mean of the former experiments, viz: 9881·086.

Desiring to ascertain whether the correction made to reduce the weight of water from 0° to 4° was sufficiently exact, M. Regnault made two direct experiments, which gave a mean differing only 0·152 or $\frac{16}{100{,}000}$ from the result of the calculation. The capacity of the globe at 0° was therefore 9·881086 lit., and since (Second Memoir, p. 360) the weight of air which filled it at 0°, under a pressure of 760 mil., was 12·7781 gr.; the weight of the litre of air under these normal circumstances is $\frac{12{\cdot}7781}{9{\cdot}881086}$ gr. = 1·293187 gr., a value notably less than that which was heretofore admitted from the experiments of MM. Biot and Arago* (1·299541).

From this and the numbers obtained in the preceding memoir for the densities of the gases we deduce, that at Paris.

The litre	of	Atmospheric Air	weighs	1·293187	grains.
"	"	Nitrogen	"	1·256167	"
"	"	Oxygen	"	1·429802	"
"	"	Hydrogen	"	0.089578	"
"	"	Carbonic Acid	"	1·977414	"

Strictly considered, these values are only correct for the locality in which the experiments were made, that is, for a latitude of 48° 50′ 14″, and a height of about 60 metres above the level of the sea.

M. Regnault finds the weight of the litre of air, under the parallel of latitude 45°, and at the same distance from the centre of the earth as that at which his experiments were tried, = 1·292697.

And, assuming this as the standard number, he deduces for any other latitude, and any other distance from the centre of the earth, the formula

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* M. Renault remarks, in a note, that all the numerical corrections made by MM. Biot and Arago, for the purpose of reducing the weight of air to 0°, and to absolute dryness, contributed to render the number which they adopted too high. Another circumstance may have produced a similar effect. These experimenters exhausted the globe several times with a very good air-pump, and they supposed that the slight tension which remained in their globe was produced by the vapor of water which the walls of the globe abandoned in vacuo, which they recondensed when the air entered again. It is, in fact, probable that this was the case, but it seems to be also very probable that when the globe was filled with air very nearly saturated with moisture, it gave a new portion of water to the glass. This portion, which was not taken into account, was considered as making a part of the weight of the air, and necessarily made that weight too great. *(See Biot's Traité de Physique, tome* 1, *p.* 367.)

$$w = 1^{\cdot \mathrm{gr.}}292697\ (1{\cdot}00001885)\frac{1}{1+\frac{2h}{R}}\ (1 - 0{\cdot}002837,\ \cos\colon 2\lambda)$$

Or, more simply

$$w = 1^{\cdot \mathrm{gr.}}292673\ \frac{\cdot}{1+\frac{2h}{R}}\ (1 - 0{\cdot}002837,\ \cos\colon 2\lambda),\ \text{in which}$$

w is the weight of the litre of air, (the litre is 61·09908 cub. inches,
R the mean radius of the earth = 6,366,198 metres,
h the height of the place of observation above this mean radius, expressed in metres,
the latitude of the place.

Applying this formula to the level of the sea, in the latitude of Philadelphia (39° 56′ 51·5″), and assuming the radius of the earth at this point 6,367,653 metres:

The weight of the litre of air will be 1·2914392 gr.

And assuming the litre as 61·09908 cubic inches, and the gramme as 15·433159 grains troy:

The weight of a cubic inch of air will be 0·32621 grs. troy.

Or, (assuming Mr. Hassler's determination of the weight of a cubic inch of water, 252·6934 gr.) water is 774·63 times heavier than air.

Density of Mercury.

The density of mercury has been determined several times by M. Regnault, and with the greatest care, as he wished to satisfy himself whether this liquid, purified by the means employed ordinarily in the laboratories, presented a constant density.

A glass globe, of a capacity of from 250 to 300 cubic centimetres, was filled with mercury. The globe terminated in a capillary tube of about 2 mil. diameter, upon which a mark was made, and this tube was surrounded by a larger one which was used as a funnel. The funnel could be hermetically closed by a ground glass stopper. The globe being filled with mercury, this liquid was boiled, and suffered to cool. The globe was then placed in ice for several hours, and the level of the mercury brought exactly to the mark. As soon as it was satisfactorily ascertained that the level of the mercury did not change, the mercury was suffered to take the temperature of the air, and its weight determined. The same globe was then filled with distilled water first boiled to deprive it of air. It was suffered to cool, the funnel being kept full of boiled water, and closed with its stopper. The globe was then surrounded with ice, and when the water had taken exactly the temperature 0°, the water level was brought to the mark, and the sides of the funnel wiped with filtering paper. The closed globe was then placed in water having nearly the temperature of the surrounding air, so as to bring it more quickly to the temperature of the air in which it was to be weighed.

The three determinations of the density of mercury, which are reported, were made at very different times, upon specimens from different sources, and in three different globes.

I. The first specimen was mercury designed for the construction of a standard barometer for the observatory of Paris. This mercury came directly from the mine; it had been twice distilled in an iron vessel. It was then suffered to stand for several days under weak nitric acid, to dissolve the oxide of mercury which always forms during distillation. The metal was then washed with much water, and dried in the air-pump.

The density of the mercury at 0°, compared with that of water at 4°, was 13·59599.

II. In the second experiment, the mercury employed was that used by M. Regnault, in the construction of his manometer. This mercury was distilled several years ago, in an iron retort, and has been kept in glass vessels. It is frequently purified by shaking it in flasks with concentrated sulphuric acid, then washing with much water.

Its density at 0°, compared with that of water at 4°, was 13·59578.

III. Recently, M. Regnault has determined the density of mercury prepared with the greatest care by M. Millon, by the calcination of crystallized nitrate of mercury in a porcelain retort. The metal was then shaken up with concentrated sulphuric acid, to dissolve the oxide.

Density of the mercury, 13·59602.

Thus we find for the densities of these three specimens of mercury:—

$$\left.\begin{array}{rl} \text{I.} & 13{\cdot}59599 \\ \text{II.} & 13{\cdot}59578 \\ \text{III.} & 13{\cdot}59602 \end{array}\right\} 13{\cdot}59593.$$

These densities may be considered as identical.

MM. Biot and Arago found the density of mercury, 13·588595.

This density differs but little from those which we have found. The little difference ought probably to be attributed to the uncertainty of the corrections, which these illustrious physical philosophers were obliged to make in their method of operating.

It is often necessary, as in measuring heights by the barometer, to know the ratio of the density of mercury to that of air.

Now 1 lit. of air at 0°, under a pressure of 760 mil., weighs 1·293187 gr.
" water at its maximum density weighs 1000·000000 "
" mercury at 0° " 13595·93 "

The ratio of the densities of mercury and air at the temperature 0°, and under the pressure of 760 mil. observed at Paris, is then 10513·5. At the level of the sea, and in latitude 45°, it becomes 10517·3, and at the level of the sea, at Philadelphia, 10527.735.

(To be Continued.)

On Chromic Acid as a Bleaching Agent, and on a Cheap and Easy Means of Recovering it. By Charles Watt, Sen.

Chromic acid has of late years become a very important agent in the bleaching of various articles, and particularly tallow and oils, more especially palm oil; the best method therefore of using and then recovering it, so that it may again be employed, and the expense of the bichromate of potassa, every time the chromic acid is required, be saved, cannot fail to prove of great advantage to all large consumers of this article.

About twelve years since, after numerous experiments and much application, I found that no agent was so effectual for bleaching foul, dark, and offensive tallows and deep-colored oils (namely, palm, linseed, and rape oils) as the chromic acid. My only consideration, therefore, was, in what manner to obtain it, in the cheapest form, sufficiently pure for the intended purposes; and the deep red salt, the bichromate of potassa, was that from the decomposition of which I obtained the acid, in the following manner:—

To bleach half a ton of dark tallow or high-colored oils, from five to ten pounds of the bichromate of potassa is required, and from it the chromic acid is liberated by decomposing the salt thus:—

The bichromate, well bruised, is put into an earthenware, wooden, or leaden vessel (not iron, as the acids act on it), and about four times as much hot water is then poured into it,—the salt is then to be well stirred; afterwards, about one pound and a half of sulphuric acid (for every pound of bichromate) is carefully introduced, and the stirring is continued until the whole of the salt is dissolved. This liquid is chromic acid, mixed with sulphate of potassa and an excess of free sulphuric acid, which is found greatly to assist in the bleaching.

The next part of the operation consists in introducing it into the tallow or oil, which, previously melted and well settled from all extraneous vegetable and animal matters, and at about 130° Fahr., is to be put into a vessel of wood, capable of holding half a ton, leaving sufficient room for stirring. So soon as the liquid mixture of chromic acid, as before described, is poured into the tallow or oil, it is to be kept well stirred, until the whole of the color is removed, and a light pea-green has taken its place. The bleaching operation is now complete, and about four pailsful of boiling water are to be poured in, and the stirring to be repeated for five minutes; the whole is then left to settle for about two hours, when it will be found quite white and fit for use.

It was formerly our custom to add about four or five pounds of muriatic acid to the compound, but Mr. C. Watt, Jr., at the large factory of Messrs. Hawes, found that it increased the trouble and expense, with no real benefit, and therefore he omitted it, and used only sulphuric acid to decompose the bichromate of potassa.

The expense of bleaching one ton of bad tallow, or any deep-colored oil, is about £1,—it therefore became necessary to devise means of saving the chromic acid; and some years since I converted the oxide contained in the green liquid, left after bleaching, into chromate of lead; but it was found that this article would become so extensive in quantity, that all who used much chromic acid would be driven into another branch of business, quite foreign to their usual occupation; and Mr. C. Watt, Jr., therefore devised the recovery of it into chromate of lime, equally as effectual as applied to bleaching, and much less in expense. His process is as follows:—

The green liquid, left after all the bleached oil is taken off, is put into another tub, and more water is added; then lime, made into a thick cream-like consistence, is gradually poured in till nearly all the sulphuric acid is saturated; the liquid is then run off into another vessel from the sulphate of lime, and into this liquid is to be gradually and carefully introduced some more of the cream of lime, till all the green oxide (powder) is precipitated, and the liquor is clear and colorless; this liquor is to be drained off, and fresh water poured in, and, when settled, it is again to be poured off, and a fresh quantity put in, in order to wash the precipitate; this is at last to be dried, and then put on an iron slab, heated to redness, and kept frequently stirred. From a green it will be gradually changed into a yellow powder, which is the chromate of lime, and which, by being decomposed by sulphuric acid in such quantity as to leave an excess of free sulphuric acid, yields chromic acid, quite as well adapted for bleaching as that obtained from the bichromate of potassa. By this process, the chromic acid can be recovered again and again, *ad infinitum*, and thus the method of bleaching by this agent is at once the most perfect and economical of any yet brought into operation.* It is almost needless to remark that where, as in the great manufactories in Lancashire, much chromic acid is employed, this easy and cheap mode of recovering it will prove highly beneficial.

It may here be remarked, that several other methods of bleaching tallows and oils have since been tried,—one consists in employing what is termed permanganic acid; but this agent so readily parts with its oxygen, that it is unmanageable, and is quite as expensive and much more troublesome. Another method is by blowing air through the goods, heated to a certain point; this, also, is found not so effectual as the chromic process, for there is considerable waste, and when made into soap, the color is much inferior. Lond. Journ. Arts & Sci.

Method proposed for taking the Votes in the National Assembly at Paris.

We take from a recent number of a French newspaper (La Vraie Republique, 25th of April, 1848,) the following ingenious contrivance proposed for determining the votes in the National Assembly.

The attention of the public has frequently been solicited of late to different projects for a similar purpose. But we do not remember to have seen one upon this principle—and we are not sure that it is not among the most simple and feasible of them all.

Each deputy is to have a ball of equal size and weight; at each seat are to be placed two small tubes, and the occupant of the seat drops his ball into one or the other of these according as he wishes to vote, *aye* or *nay*. Under each of the corridors which separate the ranges of seats are placed two larger tubes, extending from the extremities of the hall, into one of which open all the tubes destined to carry the affirmative, and into the other those destined to carry the negative votes. These tubes are established with properly calculated slopes so as to bring the balls certainly and rapidly along them, and each terminates in a counterbalanced reservoir, the adjustment of which allows the appreciation of all weights from that of a single ball up to that of nine hundred (the number of votes in the Assembly). Each reservoir acts upon a separate index hand (that for the affirmative votes being white, that for the negative black), which move over a semicircular dial sufficiently large to be divided into the requisite number of parts easily visible from all parts of the hall. The position of the hand will then at once indicate the number of votes, *aye* and *nay*.

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* The patent for bleaching and purifying dark tallows and deep-colored oils was taken out about twelve years ago by the writer.

Mean Yearly Value of the Agricultural Products of France.

We extract the annexed interesting tabular statements from a communication made to the Academy of Sciences of Paris (27th of March, 1848,) by M. A. Moreau de Jonnès, who has been engaged for the last fifteen years in studying the subject of the wealth of France.

General Table of the Mean Yearly Value of the Agricultural Products of France. (1840.)

Gross annual revenue from cultures,	5,092,116,000 francs.	
“ “ “ pastures,	646,794,905 “	
“ “ “ forests, nurseries, &c.,	283,258,325 “	
Total revenue from vegetable products,		6,022,169,450 francs.
Gross “ “ domestic animals,	767,251,000 “	
“ “ “ animals slaughtered,	698,484,000 “	
“ “ “ bees' wax and honey,	15,000,000 “	
Total “ “ animal products,		1,480,735,000 “
Total agricultural products,		7,502,904,480 “
	or $1,500,580,890.	

Table of the Comparative Agricultural Wealth of France, at Different Epochs, (omitting the Animal Products, of which no former returns can be obtained).

Date.	Reign.	Population.	Agricultural Revenue.	
			Gross.	For each inhabitant.
			francs.	*francs.*
1700	Louis XIV.	19,600,000	1,500,000,000	77
1760	Louis XV.	21,000,000	1,526,750,000	73
1788	Louis XVI.	24,000,000	2,031,333,000	85
1813	The Empire.	30,000,000	3,356,971,000	118
1840	Louis Philippe.	33,540,000	6,022,169,000	180

New Mode of Lighting by Electricity. *By* MR. STAITE.

Mr. Staite, having described his galvanic battery and other apparatus, which are on an entirely new principle of his own maturing, and which cannot be well described without diagrams, observed that the production of light from electricity was not a new thing *per se.* The experiment of the charcoal points, and the phenomena of the voltaic arc, with powerful batteries, were well known. The difficulties hitherto experienced had been—1. The economical production and application of the electric currents.—2. The discovery of a suitable material for the development of the light.—3. The rendering of the light permanent (the greatest difficulty of all). By what means, and to what extent, he had overcome these difficulties, Mr. Staite informed his audience. He produced, under a glass receiver, a brilliant light, before which the gas jets of the lecture-room turned, not pale, but yellow. "The peculiar characteristics of the electric light (said Mr. Staite) were its purity and volume. The most delicate shades of color might be detected, while the eye was not distressed by its effects. The same quantity of light, developed by gas, or any other known means, would be absolutely unendurable. That the light was not the result of combustion, strictly speaking, was evident. There could be no combustion without the presence of oxygen; and, as the light was developed to the best advantage under a closed glass, from which supplies of atmospheric air were excluded, it was quite certain that combustion had nothing to do with the matter." The light, in fact, the lecturer remarked, could be produced as readily in water as out of it. He showed its peculiar applicability to coal mining, for it could not explode the foulest atmosphere. He then came to the comparative cost of the electric and other lights. With a battery consisting of four small cells, a light was developed equal to 380 mould candles (sixes), or 300 wax candles, or 64 cubic feet of the best gas, burnt in the standard burner. This was effected by a consumption of zinc equal to 0·77, or 77-100ths of a pound, being little more than ¾ lb. of zinc per hour. When the light, however, was brought to its maximum, by increasing the distance of the electroids to their limit, the light was increased nearly threefold, whilst the current itself was reduced to about three-fifths in quantity. "This curious fact (continued Mr. Staite) I have frequently observed before. So that the light, when developed under the best circumstances consistent with its permanence, was produced by a consumption of a seventh part only of a pound of zinc per hour—and that light equal to 380 tallow candles. Assuming that the zinc so consumed was worth one halfpenny, and that the cost of the working solution, deducting the value of the products (sulphate of zinc, &c.), was as much more, we have the following comparative result:—Electric light, 1d. per hour; gas light, equal thereto, 6d. to 8d.; tallow candles, 7s. 6d.; wax, 12s. 6d." [But, in addition to the zinc and solution, an allowance must be made for apparatus, skill, labor, &c., as in the manufacture of other lights—gas, wax, tallow, &c.] In conclusion, Mr. S. observed, "By a careful comparison of all modes of effecting artificial illumination

I think I am justified in saying that there is no light so cheap as that evolved by voltaic currents of electricity; and there is certainly none which exhibits such pure and brilliant results. The absence of all smoke and flame, and noxious gases—the non-consumption of oxygen—the impossibility of its igniting surrounding substances—and the simplicity of the apparatus—are powerful recommendations for the adoption of the light in all places where purity, and brilliance, and safety, and economy, are sought for."

In the course of his address, Mr. Staite truly observed, in reference to the alleged jealousy of coal-owners, gas-makers, &c., that it was idle to throw obstacles in his way; if his electric light had superior merit on its side, it would come into use in spite of any local opposition; if, on the contrary, in practical value it was inferior to others, it would fall into oblivion. Civ. Eng. & Arch. Journ.

On the Use of Gutta Percha in Electrical Insulation. By MICHAEL FARADAY, F. R. S.

I have lately found gutta percha very useful in electrical experiments; and therefore, that others may take advantage of its properties if they have occasion or are so inclined, give you this notice for insertion in the Philosophical Magazine. Its use depends upon the high insulating power which it possesses under ordinary conditions, and the manner in which it keeps this power in states of the atmosphere which make the surface of glass a good conductor. All gutta percha is not however equally good as it comes from the manufacturer's hands; but it does not seem difficult to bring it into the best state: I will describe the qualities of a proper specimen, and refer to the differences afterwards. A good piece of gutta percha will insulate as well as an equal piece of shellac, whether it be in the form of sheet, or rod, or filament; but being tough and flexible when cold, as well as soft when hot, it will serve better than shellac in many cases where the brittleness of the latter is an inconvenience. Thus it makes very good handles for carriers of electricity in experiments on induction, not being liable to fracture: in the form of thin band or string it makes an excellent insulating suspendor: a piece of it in sheet makes a most convenient insulating basis for anything placed on it. It forms excellent insulating plugs for the stems of gold-leaf electrometers when they pass through sheltering tubes, and larger plugs supply good insulating feet for extemporary electrical arrangements: cylinders of it half an inch or more in diameter have great stiffness, and form excellent insulating pillars. In these and in many other ways its power as an insulator may be useful.

Because of its good insulation it is also an excellent substance for the excitement of negative electricity. It is hardly possible to take one of the soles sold by the shoemakers out of paper or into the hand, without exciting it to such a degree as to open the leaves of an electrometer one or more inches; or if it be unelectrified, the slightest passage over the hand or face, the clothes, or almost any other substance gives it an electric state. Some of the gutta percha is sold in very thin sheets, resembling in general appearance oiled silk; and if a strip of this be drawn through the fingers, it is so electric as to adhere to the hand or attract pieces of paper. The appearance is such as to suggest the making a thicker sheet of the substance into a plate electrical machine for the production of negative electricity.

Then as to inductive action through the substance, a sheet of it is soon converted into an excellent electrophorus; or it may be coated and used in place of a Leyden jar; or in any of the many other forms of apparatus dependent on inductive action.

I have said that all gutta percha is not in this good electrical condition. With respect to that which is not so (and which has constituted about one-half of that which, being obtained at the shops, has passed through my hands,) it has either discharged an electrometer as a piece of paper or wood would do, or it has made it collapse greatly by touching, yet has on its removal been followed by a full opening of the leaves again; the latter effect I have been able to trace and refer to a conducting portion within the mass covered by a thin external non-conducting coat. When a piece which insulates well is cut, the surface exposed has a resinous lustre and a compact character that is very distinctive; whilst that which conducts has not the same degree of lustre, appears less translucent, and has more the aspect of a turbid solution solidified. I believe both moist steam-heat, and water-baths are used in its preparation for commerce; and the difference of specimens depends probably upon the manner in which these are applied, and followed by the after process of rolling between hot cylinders. However, if a portion of that which conducts be warmed in a current of hot air, as over the glass of a low gas flame, and be stretched, doubled up, and kneaded for some time between the fingers, as if with the intention of dissipating the moisture within, it becomes as good an insulator as the best.

I have soaked a good piece in water for an hour; and on taking it out, wiping it, and exposing it to the air for a minute or two, found it insulate as well as ever. Another piece was soaked for four days and then wiped and tried: at first it was found lowered in insulating power; but after twelve hours' exposure to air under common circumstances it was as good as ever. I have not found that a week's exposure in a warm air cupboard of a piece that did not insulate made it much better: a film on the outside became non-conducting; but if two fresh surfaces were exposed by cutting, and these were brought into contact with the electrometer and the finger, the inside portion was still found to conduct.

If the gutta percha in either the good or the bad condition (as to electrical service) be submitted to a gradually increasing temperature, at about 350° or 380°, it gives off a considerable proportion of water; being then cooled, the substance which remains has the general properties of gutta percha, and insulates well. The original gum is probably complicated, being a mixture of several things; and whether the water has existed in the substance as a hydrate, or is the result of a deeper change of one part or another of the gum, I am not prepared to say. All I desire in this note is to make known its use in the arrangement of extemporary or permanent electrical apparatus for the advantage of working philosophers, both juvenile and adult.

Royal Institution, Feb. 9, 1848. Lond. Phil. Mag.

Explosion on Board a Vessel laden with Steam-coal.

An inquest was held at the Town-hall, Cardiff, on Thursday last, before R. L. Reece, Esq., coroner, on view of the body of J. Grocey, chief mate of the barque *Neptune*, of Jersey, now lying in the Bute Dock. It appeared in evidence, that the vessel above-named was loaded with steam-coal, and was lying near Mr. Powell's wharf. On Wednesday night, the deceased having lighted a lucifer match, a terrific explosion took place in the hold, by the force of which the whole of the cabin and main hatchway were blown to atoms. The capstan was blown up to the height of the main rigging. The mate was killed on the spot—his remains presenting a most frightful spectacle. A boy named R. Smith, had his hands and face burnt but not severely; and another boy had his hair and eyebrows singed. The captain and his wife, who usually slept on board, were on shore that night. The damage sustained by the vessel is estimated at £400. Verdict—Accidental Death. [Accidents of this nature may be avoided by merely taking the precaution of keeping open the hatches for a few hours after the shipment of the cargo, that the gas, which is occasionally evolved from the Merthyr coal, may escape.] Lond. Min. Journ.

New Method of preparing Chloroform. By Prof. Böttcher.

Equal parts of chloride of lime and acetate of soda are distilled to dryness in an iron retort. But little chloroform is obtained in the first distillation, but a large quantity of dilute acetone, which is mixed with chloride of lime, and submitted to a second distillation. But the whole of the acetone is not decomposed in this operation, and it is consequently necessary to mix the product with more chloride of lime, and again distil. The product is rectified over caustic lime. This method is said to effect a great saving. Lond. Chem. Gaz.

BIBLIOGRAPHICAL NOTICES.

Elements of Natural Philosophy, being an Experimental Introduction to the study of the Physical Sciences, by Golding Bird, M. D., &c., &c., *with* 372 *Illustrations. From the Revised and Enlarged Third London Edition. Philadelphia: Lea & Blanchard,* 1848.

The work of Dr. Bird was intended, as he has stated in the preface to his first edition, as an introduction to the study of more elaborate works upon the subject. It would not therefore be fair to examine it for the purpose of criticism, under any other view. The want of a work of this kind was very much felt by the English student; for while the higher works upon the subject were unnecessarily filled with mathematical demonstrations to such an extent, that the physical ideas were, in not a few instances, entirely lost sight of, the lighter works, which professed to avoid the use of the mathematical forms of reasoning, and to adapt themselves more exclusively to popular perusal, were very generally written by authors ignorant of the subjects of which they professed to teach, or else more bent upon illustrating their own eloquent style of writing, than the phenomena of Nature. They were therefore essentially either incorrect or imperfect, and generally both. The principal apparent exception to this assertion, is the admirable work of Dr. Young; but beside a certain obscurity of expression in the explanations of Dr. Young, which renders his work less advantageous than it at first appears, to one altogether ignorant of the subject, the book had become obsolete by the rapid advances of sciences since the author's time, and the new edition by Mr. Kelland, though an interesting and beautiful book, does not by any means correct this defect.

The want of a work of the kind which Dr. Bird proposed to furnish,was therefore much felt in the English language, and the method in which his work was executed, fully supplied the deficiency. The treatises upon the various subjects comprised under the general term Natural Science, are full and generally accurate, and they are so arranged as to connect them together in their proper order in the mind of the reader, and thus present the science as a whole, and not as a mere conglomerate of totally dissimilar parts.

The third edition introduces in their proper places the discoveries and improvements which have been made in the science, since the others were published, and presents to the student the most recent view of the subject.

We regard this book as a very valuable one, and can affirm that it fulfils the purpose for which it is intended; it is written by a gentleman fully versed in the matters of which he writes, and in a plain, and unornamented style, which renders it easily comprehensible.

The mechanical execution of the work by Messrs. Lea & Blanchard, is unexceptionable, but we cannot but regret that the system of beautiful illustrations which so profusely adorn the far inferior work by Müller was not applied to render still more popular the excellent treatise of Dr. Bird. F.

Chemical Technology, or Chemistry applied to the Arts and Manufactures; by Dr. F. Knapp, *Professor at the University of Gressen. Translated and edited, with numerous notes and additions, by* Dr. Edward Ronalds, and Dr. Thomas Richardson. *First American Edition, with notes and additions by Professor* Walter R. Johnson, *of Philadelphia. Vol.* 1, *illustrated with* 214 *engravings on wood. Philadelphia, Lea & Blanchard,* 1848; *8vo. pp.* 504.

This is the third volume of the series of illustrated scientific works re-published by Messrs. Lea & Blanchard, and we think it will prove the most popular, as it is decidedly the best of the series. Written by one who has for many years studied both theoretically and practically the processes which he describes, the descriptions are precise, and conveyed in a simple unpretending style, so that they are easily understood, while they are sufficiently full in detail, to include within them everything necessary to the entire comprehension of the operations. The arrangement in groups of those branches of industry, which are allied together by some general theory common to them all, is a very happy idea, and while it renders the study easier, it adds to it additional interest. The work is also carefully brought down to include the most recent improvements introduced upon the continent of Europe, and thus gives us full descriptions of processes to which reference is frequently made in other works, while many of them are, we believe, now for the first time, presented in a complete state to the English reader. The English editors have also performed their task with talent and faithfulness, as is evidenced by the large and judicious additions which they have made, describing British inventions and improvements, and giving us the latest results of British science and ingenuity. Professor Johnson, the American editor, has also added to the collection, several contributions of interest to the American reader, among which we would particularly notice the table of the results of the experiments of Mr. Bull, upon the different kinds of wood used as fuel; and a digest of his own elaborate investigations into the relative values of different American coals.

But we regret to find that in reference to one of the most interesting subjects treated of in this volume,—that of the Manufacture of Gas for purposes of Illumination,—Professor Johnson has suffered his private prejudices to betray him into a serious violation of his duties as an editor, and has added an appendix containing strictures upon the gas works of our city, as inaccurate in their statements as they are misplaced in a work of this character. They are misplaced because, for the most part altogether unconnected with a treatise upon technological chemistry. If it can be shown that the superintendent of the gas works at Philadelphia, wastes in the process of manufacturing the gas, either the coal or the fuel, or makes a gas of less purity or of smaller illuminating power than he should, from his materials, then such defects would perhaps be proper subjects for comment in a work of this kind. We say perhaps—for we believe after all that the same space would be much more usefully employed in describing processes by which other operators did better. Professor Johnson does indeed charge a wastefulness of fuel, (though we are satisfied that if he will inquire of Mr. Cresson, he will find himself in error in his conclusions,) and a brief temporary defect in the purity of the gas, (arising as he well knows, from the incapacity of the purifiers then in use, to hold the quantity of material necessary for the enormous increase in the demand for the gas; and ceasing as soon as new purifiers of a larger size could be made). So far then as these two charges are concerned, our remark as to the misplacement of his criticisms does not apply. But in reference to the others, to a student of technology, or even to the general reader, they are altogether superfluous. The secondary products being once produced, the question of their disposition is one of pure economy—and as, with the exception of the coke, nothing can be done with them, except sell them, it is no longer a matter of science or of art. The proper body, therefore, before whom to arraign a careless or dishonest superintendent, is the Board of Trustees, or if they are involved in the accusation, or will not entertain the complaint, the public, or the City Councils. And in any case, the fair and proper vehicle for the discussion, are the newspapers, where both parties may be fully and fairly heard. The editor of a book has no right to saddle his author with such charges which are necessarily unjust, because no reply is possible. The misplacement of these criticisms is moreover aggravated by the fact, that in truth, these, or very similar statements, have just been the subject of a very warm newspaper discussion, the upshot of which has been, we believe, the entire vindication of the management of the gas works. That the statements are inaccurate, might easily be shown, if our Journal were the proper vehicle for entering upon the discussion, and will doubtless be made manifest if the question be again raised in the proper quarter. But a more painful feature of these criticisms are the strange and most unwarrantable insinuations, which are introduced against the motives of those who have these works under their control. Against whom these are especially directed, whether against the superintendent, or the trustees, individually or collectively, we do not choose to inquire, but they manifest a spirit which is altogether unbecoming in an editor, and unworthy of a man of science. They indicate a personal feeling, which cannot be mistaken, and which will not, we think, increase the confidence of the reader in the charges with which they are accompanied. We hope that Professor Johnson, when he revises calmly these pages of his work, will see the error into which he has been led, and with this hope we strongly commend the original work, the additions of the English editors, and those of Professor Johnson, where he has not permitted his personal feelings to draw him into ill-timed and ill-deserved criticisms, upon what he has evidently not taken the pains to understand.

The mechanical execution of the work is of the same high character which distinguished the others, and we again especially call attention to the wood-cuts, as fine specimens of the perfection which our workmen have attained in this kind of printing. F.

FRANKLIN INSTITUTE.

Proceedings of the Stated Meeting, held May 18th, 1848.

Dr. R. M. Patterson, President P. T., Presiding.

Present, 31 Members.

The following Donations were announced:—

From Petty Vaughan, Esq., London—

A Catalogue of Specimens of Recent British Manufactures and Decorative Art, exhibited at the house of the Society of Arts, in London, from March 8th to April 20th, 1848.

From Hon. Charles Brown, Member of Congress, Washington, D. C.—
Congressional Documents of the United States Senate.
A Report from the Secretary of State, with the Correspondence of Mr. Wise, late United States Minister to Brazil, in relation to the Slave Trade.
From Hon. James D. Westcott, Jr., Senator of the United States, Washington, D. C.—
Congressional Documents of the House of Representatives.
Report of the Committee on Naval Affairs, in relation to the Alabama, Florida, and Georgia Railroad.
From R. P. Anderson, Esq., Washington City, D. C.—
Congressional Documents of the *Senate.*
Report of the Secretary of the Navy—of the Plans and Construction of the Depot of Charts and Instruments, with a Description of the Instruments, &c.
Report of the Secretary of the Treasury—containing the Annual Report of the Commissioner of the General Land Office.
Congressional Documents of the *House of Representatives.*
Letter from the Secretary of War, transmitting Statements of Contracts under Authority of the War Department.
Report of the Secretary of the Navy, in relation to the floating Dry Docks at Pensacola, Philadelphia and Kittery.
From Solomon W. Roberts, Esq., Philadelphia.
The First Annual Report of the Inspectors of the Philadelphia County Prison, made to the Legislature, February, 1848.
From Messrs. M'Clees & Germon, Lithographers, Philadelphia, Pennsylvania—
Lithographic Likeness of Joseph R. Chandler, Esq.
From Joseph Harrison, Jr., Esq., Russia—
Lithographic Likeness of Nicholas I, Emperor of Russia.

The Reports from the Officers and Standing Committees were received.

Three new Members were elected, and four gentlemen were proposed for election at the next meeting.

Verbal Communication from Dr. Hare, on the Rationale of the Explosion causing the Great Fire of 1845, *at New York. (See Proceedings of the Franklin Institute, for 20th April last, page* 392.)

Dr. Hare communicated to the meeting some inferences and facts, tending to explain the contradictory impressions which have existed respecting the competency of fused nitre to explode with water, or with aqueous, hydrogenous, and carbonaceous combustibles. This subject was treated of in reference to a series of detonations terminating in an explosion of tremendous force, by which, in July, 1845, the intensely ignited contents of a store, in Broad street, New York, were thrown over an extensive district, involving the destruction of about 200 houses and property estimated at two millions of dollars. As far as the oaths of highly competent witnesses could avail, no gunpowder was present; so that the result could only be attributed to the reaction between an enormous quantity of nitre and combustible merchandise with which the store was promiscuously occupied. In all there were three hundred thousand pounds of nitre in parcels of 180 lbs. (each secured by two bags, an additional bag having been put over that originally employed).

About 180,000 lbs. was situated upon the second floor, 50,000 on the first floor, and 80,000 on the third floor.

Of the merchandise, the aggregate was more than double the weight of the nitre.

It was, however, the general opinion of those best acquainted with the subject, that when ignited with combustibles, nitre produces only that species of combustion which is called deflagration by chemists, without being capable of the more violent and instantaneous reaction designated by the word explosion. This impression was strengthened by the failure of every effort (made by several eminent chemists employed by the Corporation of New York) to explode nitre by ignition with combustibles.

Nevertheless, agreeably to Hays, of Massachusetts, an explosion was effected in his laboratory, by bringing water into contact with about 100 lbs. of incandescent nitre; also the accidental falling of a jet of melted nitre on some water, in the laboratory of the University of Pennsylvania, had been productive of a similar result.

The explosion of a vessel ladened with nitre, which, while lying in Boston harbor, was burnt to the water's edge, and of others similarly ladened and burnt, could only be explained by supposing that nitre, when sufficiently heated, will explode with water on due contact. Consistently, it might be inferred that this salt (well known to be a compound of nitric acid and oxide of potassium or potash) would explode with any substance capable of yielding either or both of the elements of water or hydrogen. The presence of the latter would be equivalent to water, since it would, with the oxygen of the acid, form water.

In a letter, addressed to the distinguished chemist above mentioned, in July, 1845, Dr. Hare had adverted to the explosion which succeeds the combustion of potassium upon water, as arising from the combination of one portion of the water with the resulting incandescent globule of oxide, while the heat of this globule uniting with another portion of the liquid, converts it into high steam. Moreover, it was suggested that in this instance, chemical affinity between the water and the oxide, in causing the water and heated globule to coalesce, is equivalent in efficacy to the momentum of the hammer when a bar of iron, at a welding heat, is forced into contact with some moisture situated upon an anvil.

Dr. Hare presumes that no explosion can take place unless the reagents for producing it are held or brought together, at the moment of reaction, by a certain force, either chemical or mechanical.

Some chemical compounds, such as are formed with fulminic acid, or with ammonia, by metallic oxides, also the chloride of nitrogen and perchloric ether, explode violently without confinement, so as to fracture a plate or saucer, upon which a small quantity may be detonated; but pulverulent mixtures, such as gunpowder, however powerfully explosive when employed in gunnery or rock-blasting, in open vessels flash without fracturing them, or producing any report. In an exhausted receiver, gunpowder is far less explosive than when subjected to atmospheric pressure in an open vessel. Nevertheless, when gunpowder is restrained until the temperature requisite for the appropriate reaction of its ingredients is attained, it exerts a force far exceeding that of the chamber confining it. In this respect it differs from steam, of which, when the temperatnre of the fire applied is sufficiently high, the explosive force is directly as the pressure before bursting, and this, of course, is commensurate with the strength of the confining boiler.

The ingredients of gunpowder, sulphur, charcoal, and nitre, to produce the greatest effect, require extreme comminution and intimate intermixture by trituration, and to be so granulated, that the flame of the portion first ignited may convey inflammation to the rest through the interstices between the grains. Its superiority over any other mixture of nitre with combustible matter destitute of sulphur, is conceived to be due not only to the pre-eminent susceptibility of this substance, of vaporization and inflammation, but likewise to its well known ability to decompose metallic oxides by attracting both the metal and oxygen. Since an opinion was expressed in 1845, in the letter above mentioned to Hays, that the formation of sulphide of potassium is the first step in the process of the explosive reaction of gunpowder, Faraday has alleged the flame of this compound to be, in the case in point, an important instrument in the propagation of fire throughout the mass.

The hepatic odor of the fumes consequent to the firing of cannon, and likewise of the washings of a gun after the customary service, demonstrate the production of a sulphide. It has been found that a filtered solution of the residue displays, when tested by iron, the red hue which indicates the presence of a sulphocyanide.

Agreeably, however, to a qualitative examination, the solid residue of exploded gunpowder consists mainly of nearly equal parts of carbonate and sulphate of potash, while the gaseous residue is constituted nearly of equal volumes of carbonic acid and nitrogen. Of course the sulphate may arise from the oxidation of sulphide, formed at the outset. Notwithstanding that the ingredients of gunpowder are prepared as above stated, confinement is necessary to prevent the grains from being thrown apart and chilled, so as to prevent the propagation of the ignition, through the congeries forming a charge, by means of the flame of the first portions fired. This was fully demonstrated by the exposure of a pile of gunpowder comprising enough for the charge of a musket, within an exhausted receiver, to a wire intensely ignited by a galvanic discharge. The grains did not take fire instantly, probably because the vapor evolved prevented actual contact; and when ignition did ensue it extended only to the production of a feeble flash. On examination, it was found that a portion of the powder had escaped inflammation.

In the next place, a like weight of gunpowder was consolidated into a cylinder by intense pressure. Thus prepared and ignited, by contact with an incandescent wire in the exhausted receiver, more than half of the cylinder remained unconsumed.

A much larger cylinder of the same mixture, similarly consolidated, placed at the bottom of an iron pot, four inches in diameter and twelve inches in depth, on being touched by the end of an iron rod reddened in the fire, burnt at first like a squib, but towards the last was dissipated with an activity in some degree explosive, probably in consequence of the pressure created by the reaction of the gaseous current generated by its own deflagration.

The want of confinement, which is thus capable of lessening the explosiveness of gunpowder, of which the constituents are intimately intermingled, is still more enfeebling, where analogous reagents are ignited together without admixture or comminution. Under these circumstances, the reagents are made to recede from each other by the generation of that vapor or gas, to the evolution of which, under confinement, the capability of exploding is due. Thus sundered, they are chilled by radiation, so that the temperature requisite to sustain and communicate ignition is not supported. Moreover, the rapidity of reaction being as the multiplication of the points of contact, and these being fewer as the substances are less divided and intermingled, the deflagration takes place in detail, instead of having that simultaneousness which is indispensable to render it explosive.

In addition to the ideas above mentioned as having been conveyed in Dr. Hare's letter to Hays, it was urged, also, that his inference as to the explosion of water with incandescent nitre being attributable to a reaction analogous to that represented as taking place when potassium is burnt with the oxide of potassium, was supported by the fact, that at a white heat, the base of nitre spontaneously abandons its acid, while from water it cannot be separated by any temperature. Consequently. the presentation of substances, consisting of carbon, hydrogen, and oxygen, by yielding water to the base, could not but be productive of a result analogous to that which results from the presentation of sulphur and carbon.

The only obstacle is as follows:—Substances containing hydrogen and oxygen, whether in the proportion for forming water, like sugar, starch, gum, and wood; or having an excess of hydrogen, like oils and resins; moreover, all the constituents of nitre, even the base, are susceptible of the aeriform state at the temperature producible by the reaction of nitre with them. But when kept together until that point is attained, the explosive power must be fully equivalent to that of gunpowder. The reagents are in a state analogous to that of two gases extremely condensed.

The explosibility of incandescent nitre with water was illustrated in the small way, by heating a portion in a platina capsule by the flame of a hydro-oxygen blowpipe, and sudden immersion in the liquid. So active was the explosion, that a portion of the resulting hydrate flew out upon the operator. Yet, when thrown in the same state upon molasses or sugar, no explosion ensued: nevertheless, when a capsule containing nitre heated to the point of volatilization, was struck with the face of a hammer, coated with suger melted upon it and made to adhere by moisture, a detonation took place; a still more powerful detonation was produced as follows:—

Upon an anvil, a disk of paper, of three inches in diameter, was laid, covered with pulverized sugar. Over the sugar was placed another similar disk covered with pulverized nitre. A bar of iron, rather wider than the disks at a welding heat, was then held over them, and subjected to a blow from a sledge. An explosion, with a report like that of a cannon, ensued.

Instructed by the facts and considerations above stated, it is inferred that the explosions which contributed to extend the conflagration in New York, as above mentioned, arose from the reaction of the nitre with the combustible merchandise with which it was surrounded. It is presumed that as soon as the fire reached any of the gunny bags, it must have run rapidly through the whole pile, by means of the interstices necessarily existing between them, the nitre with which they were embued causing them to deflagrate. Much of the salt being thus brought to the temperature of fusion, it must have run about the floor, reached the combustibles, and soon found its way to the next story through the scuttles which were open. All the floors must have been rapidly destroyed by the consequent deflagration, far exceeding in activity any ordinary combustion. Meanwhile, the nitre being all liquified and collected in the cellar in a state of incandescence, and the merchandise conglomerated by the fusion of sugar and shell lac, aided by the molasses, the weight, the liquidity, and temperature, must have produced all the conditions requisite to intense detonations. The floors having been consumed, the store must have been equivalent to an enormous crucible of twenty feet by ninety, at the bottom of which were nearly three hundred thousand pounds of nitre, superficially heated far above the temperature producible by any furnace so as to convert the reagents into nascent aeriform matter under a pressure of half a million of pounds. The intense reaction, however, would not permit of durable contact. At each impact, the whole mass must have been thrown up explosively, and hence the successive detonations. But the chemical reaction, the heat, and the height of the fall, growing with their growth, and strengthening with their strength, the last elevation was succeeded by the thundering report and stupendous explosion, of which it has been an object to afford a satisfactory explanation.*

COMMITTEE ON SCIENCE AND THE ARTS.

Report on the Explosion of a Steam Boiler.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, by whom were appointed a sub-committee to examine into the cause of the explosion of a stationary engine in Dillwyn street, Philadelphia, on the 20th day of March, 1848, Report—

That they examined the fragments of the boiler, and found that it had been cylindrical, 14 feet in length, and 18 inches in diameter, made of iron $\frac{1}{8}$ inch thick, and apparently not of very good quality. The rupture had taken place nearly in the middle of its length, and presented the appearance of a clean cut around the boiler, just at the edge of one of the sheets of which it was composed, and exactly along the line which must have been followed by the caulking-tool. There was no tearing of the body of the sheet, and no irregularity in the line of fracture, except for about $\frac{1}{2}$ inch in length at the lowest part, where there were some slight irregularities, as though the iron had torn there, after the rest had given way. Upon a closer inspection the mark of the caulking tool was plainly visible, and it was seen to have cut into the iron, sometimes to a considerable depth. The committee have no doubt that this carelessness in caulking the boiler materially weakened it, and thus determined the line of the fracture. It is proper to remark that it was stated to the committee, that the cylinder was not constructed for a boiler, but had been used as a condenser, and was bought by its late proprietor at second hand, and by him applied as a boiler.

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* In a short time a more circumstantial account of Dr. Hare's experiments and inferences respecting the subjects of the above communication will be published.

The boiler had been placed in the second story of a frame building on the east side of Dillwyn street, and in the rear of the lots attached to the houses on Third street, and was used by a Mr. Reeve, to drive a small engine for the purpose of cutting tobacco. The boiler lay east and west, slightly inclining downwards to the east, which was the fire end. The fire-way extended from the front, backwards, beneath the boiler, and was then returned by an outside flue, which lay above the ordinary water-level of the boiler. A blower was attached to the engine; it appeared to have been recently added, and gentlemen who were familiar with the premises, asserted that there was nothing of the kind when the boiler was first erected. The chimney stack being destroyed, the committee could not determine whether any defect had existed in the draft.

The westward or back part of the boiler had passed through the front of the house, and struck the dwelling on the opposite side of Dillwyn street, driving in the front wall. The fire end of the boiler passed across the whole lot between it and the houses in Third street, a distance of 112 feet, and struck the edge of a doorway, in an 18 inch wall, which it destroyed. Both these projections indicate a great force of steam; and upon examination the committee found a distinctly marked water-line, showing that the depth of water at the point of fracture was only about 3 inches. There were, however, no conclusive marks of high heat on the iron.

Although the thickness of the iron had been reduced by the cutting of the caulking-tool, and although the iron did not appear to be of very good quality, yet the committee believe that it was capable, with proper care, of bearing with safety, any pressure necessary for the light work which the engine had to do. Assuming the iron to have been but $\frac{1}{16}$th inch thick, and taking its tensile strength at 50,000 lbs per sq. inch, it would have been capable of resisting a strain in the direction in which fracture took place, of more than 45 atmospheres pressure.

It is a little singular that the boiler should have given way in the direction in which, by theory, it is considerably the strongest. For a tearing strain in the direction of the axis of the boiler, the resistance would have been equivalent to but 25 atmospheres, (347 lbs. per square inch,) if we take 50,000 lbs.

A very simple calculation will suffice to show that the pressure within the boiler at the moment of explosion was enormous. In fact, if we suppose the boiler lying quite horizontal, the projectile force was sufficient to carry the eastern fragment over 112 feet, while it fell 12 feet by the action of gravity, that is in 0·866 sec. The projectile force, therefore, gave to a mass of about 300 lbs, a velocity of 130 feet per second.

In the opinion of the committee, therefore, the explosion of this steam boiler was owing to an excessive pressure of steam, probably generated instantaneously by the admission of water to overheated metal, and the line of fracture was determined by the weakening of the iron at the junction of two of the plates, by the careless use of the caulking-tool.

By order of the Committee,

William Hamilton, *Actuary.*

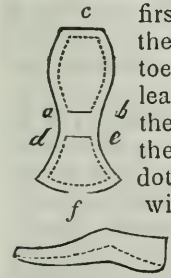
Report on MM. Durand & Pecqueur's *process for manufacturing various articles from Leather.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination the process for manufacturing various articles from Leather, invented by MM. Durand & Pecqueur, Paris,

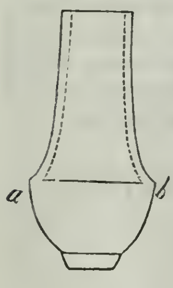
Report—

That they have examined with much satisfaction the various articles which have been brought before them by Mr. Rabeau, manufactured in leather by the process invented by MM. Durand & Pecqueur of Paris, of which process Mr. Rabeau is the patentee in the United States. They have likewise inspected the machine by which the various manufactures are produced. The patent is claimed for a method of manufacturing various hollow articles of leather without seams, such as fire-hose, sword, and bayonet scabbards, canteens, shot pouches, cartridge boxes, military caps, boots and shoes, cigar, and spectacle cases, &c., &c. The principle of the method is to divide the leather in a moistened state, in the direction of the plane of its length and breadth, making in the case of fire-hose, a slit through its entire length, leaving a border on both edges of the strip uncut. This is performed by means of a short knife at the end of a steel rod to which an alternate lateral motion is communicated by a peculiar mechanism; and this operation is performed with so much accuracy, that the slit is made directly through the centre of the strip of leather, leaving the two sides everywhere of the same thickness, supposing the original strip to be of a uniform thickness. In the case of sword and bayonet scabbards, a mandrel is introduced, by which the piece can be made to assume the proper form and stiffness when dried.

In the manufacture of canteens, a piece of leather is taken of the requisite shape, which is a little broader than the vertical section of the canteen through its length and greatest breadth, in which a slit is cut so as to leave the uncut border everywhere of the same breadth. The leather is in the wet state when cut, and is filled with sand and a plug driven into the mouth, then dried, after which it retains the shape thus given to it, and may then be finished according to any of the ordinary methods. Melted wax, or a preparation of wax, is poured in the inside, which fills the pores of the leather, and prevents the infiltration of the liquids which it is intended to contain, and further from acquiring any unpleasant taste from it. Mr. Rabeau proposes to finish his canteens by subjecting them when filled with sand to pressure in proper moulds, by means of an hydrostatic press. His helmets and military caps are fitted on blocks, from which they take the proper shape.



Mr. Rabeau manufactures by this process a shoe, of a single piece of leather, excepting the heel-tap, even to the ties. A piece of sole-leather is taken of the form represented in the figure. The knife is first introduced along the line *a b*, slitting the leather in the shape of the dotted line to the end *c*, thus forming the toe. It is again introduced along the line *d e*, slitting the leather according to the shape given by the dotted line to the end *f*, forming the heel. When a last is introduced, the uncut border assumes the position represented by the dotted line in the figure. This border is then pared down with the knife so evenly, that in the finished shoe, the edge cannot be distinguished from the sides of the leather. A very neat article of the species of overshoes, called *clogs*, is fabricated by this method. There is not a seam in the shoe being all of one piece, except the heel.



The legs and uppers of boots are made likewise without seams. The original piece of leather is of the form given in the figure on the margin. The knife is entered at the line *a b*, and the heel and leg are formed by a slit of the shape given by the dotted line. The method generally adopted, however, is to have two short seams on each side of the boot-leg, near the sole. The boot is then finished in the ordinary manner. A very neatly finished boot was shown to the committee, the upper leather of which was finished in this manner. Also a shoe, the leather of which however, was not curried or dressed. Mr. Rabeau proposes to furnish a common kind of boot only by this method. The shape is given to the boots and shoes by the trees and lasts, while the leather is wet, and Mr. Rabeau thinks that when the leather is dressed and oiled, after the shape is given to the boot or shoe, it will always be retained in all circumstances of moisture and wear.

It is the opinion of the committee, that the process of MM. Durand & Pecqueur, is a great improvement over the old method of the manufacture of scabbards, canteens, and articles of a like description, avoiding as it does, all seams, and thus freeing it from the greatest liability of damage, and wear and tear, in use. The inner surface is perfectly clean and smooth.

Their method of manufacturing fire hose is one saving the labor of rivetting to a great extent; rivets being used only to join the strips after they have been slit. Whether, however, the leather in this state of diminished thickness, will be found sufficiently strong to meet the exigencies of the fire service in our cities, or in other large cities, the committee are not prepared to say. Experience can only pronounce with certainty. It is observed that the common hose wear most at the lines of rivets running across the general length of the hose. This of course will take place in the hose made according to the new process. Mr. Rabeau thinks his hose has an advantage over the common in reeling off and on the carriages, from the fact of its being nearly, if not perfectly flat, when not filled with water. A section of hose manufactured by Mr. Rabeau, was subjected to a pressure of 120 lbs. on the square inch, which it withstood successfully.

Another important application of this invention, is the covering of the draw-rollers of cotton spinning machines. There are objections to the old methods of wrapping the leather around the cylinder, and then sewing or glueing it as tightly as possible. It is found that the leather gradually stretches and works loose, and then is obliged to be removed or tightened. And further, it is found that it is difficult to get a perfectly round cylinder, on account of the seam. And as uniformity in the size of the thread depends upon this latter circumstance, any method which may overcome the difficulty is important. By the new process a slit is cut in a piece of leather of the proper size, and driven on to a metallic cylinder, which it is made to fit very tightly, and then placed in a lathe and turned perfectly smooth and round. It may be objected that the leather thus embracing the metallic cylinder so tightly, may lack the requisite degree of elasticity to accommodate any irregularity in its surface to the size of the thread. But it may be answered, that from the perfectly cylindrical shape which may be given to the roller, the leather does not require the same degree of elasticity. It seems to be an important improvement, and worthy the attention of those engaged in that branch of manufactures.

By order of the Committee,

William Hamilton, *Actuary.*

Philadelphia, May 11, 1848.

GLOSSARY OF MINING TERMS.

(From the London Mining Journal.)

(Continued from page 320.)

SOUTH STAFFORDSHIRE.

Air-head—A channel 2 feet 3 inches by 3 feet 6 inches, driven on a level with the top of the gate-road, and about 4 yards on one side of such gate-road.
Bildas, or *Buildhouse*—The men going down at 6 and working till 9, and sometimes 10 o'clock, is termed a bildas, for which the men get nothing but a drop of beer. This was originally denominated *buildhouse*, from the fact of the butty being able to *build* so many *houses* from the exactions thus made upon the men.
Blowing-tools—A small set of blasting implements.
Breakes—Are fissures, or cracks, that are found in working near old works, arising from the consolidation of such old workings.
Back-horse—The horse that draws the loading skip from the loaders to the wagon hole.
Bolt-hole—A passage same size as gate-road, but leading from the gate-road into a side of work, in which the dams are generally placed.
Bandsman—A man who loads up the coal.
Banksman—A man who lands the skip at surface.
Bow—A piece of wrought-iron passing from one side to the other of a skip, by which it is let down into the mine.
Bating—Lowering the gate-road, or other passage.
Benching-up—Holing above the measure, and then breaking up the lower part.
Bowke—A small wooden box, used for drawing clay and ironstone, and for sinking.
Butty—A getter of coals, or ironstone, by contract by the ton.
Curb—A circular piece of wood, pinned together as a foundation for the bricking of a shaft.
Crop—The line of inclination of a mine.
Calcining—Roasting iron ore.
Charter Master—See *Butty.*
Cutting—The coal being cut perpendicularly round the pillars and ribs, in order to let the coals fall.
Cog—A small square building of rough stones, or coals, left to support the roof during the operation of holing.
Cropping-out—When the seam crops out at surface.
Doggy—An underground superintendent, employed by the butty.
Downfall—A downthrow.
Dialling—Surveying the different ramifications of the mines by means of the magnetic needle.
Dresser—A large pick, used for preparing the large coals for loading into the skips.
Driving—Cutting and blasting horizontally, to make a level, or air-way, &c.
Dip—The line of depression of a mine.
Dan—A small wagon, used in ironstone mines.
Damp—Carbonic acid gas.
Dog-hook—A long hook, by which the empty skip is drawn in any direction.
Damp Sheet—A large coarse sheet, placed across the gate-road, to force air in another direction.
Doors—Stoppings for air in main gate-road.
Draught—The quantity of coals raised to bank in a given time.
Drink-time—Meal-time.
Drum—That part of the winding machinery on which the rope or chain is coiled.
Drop—Applies to a quantity of coal caused to drop by cutting—sometimes the thickness of 3 feet, and at others of 6 feet.
Druggon—A square wrought-iron or wooden box, used for lowering clear water into the mine for the horses, and for conveying water into the interior, &c.
Dams—Stoppings of fine sand and brickwork, of various thicknesses, in the gate-roads, to exclude the atmospheric air from old workings, to prevent spontaneous combustion.
Engine-pit—The pumping-shaft.
Elve—The handle of a pick.
Fault—A dislocation, with rock, or other foreign matter, lying between.
Fire-stink—Arises from the decomposition of iron pyrites, which is so abundant; hence the necessity of ribs, dams, &c.

Fast-end—The part of a face that juts against the solid.

Foot-hook—The large hook that is hooked to the bow of a skip, or tacklers, in drawing coals up the shaft.

Foot-hook chain—A strong chain at the end of the rope, and connected with the foot-hook.

Face—In ironstone mines, the work in progress.

Fleaing—Is practised when a gate-road, or other work, is about to be abandoned, as a system of robbing, as it is termed in the north, or an endeavour to thin the ribs to the greatest extent.

Fighting—Applies to the ventilation when reversed—as the upcast becoming the downcast, and *vice versa.*

Ground Bailiff—A superintendent, visiting the mines about once a week; has the entire directions, and should be made answerable for all accidents from breakages, bad ventilation, &c.

Gin—A wooded drum, with vertical shaft, cross-piece, beam, &c., by means of which shallow mines are realised.

Gate-road—A passage driven on the floor of the coals about 10 feet wide and 10 feet high, used to carry the coals along.

Gob—The refuse that is left behind when the work is completed, as small coal, earthy matter, inferior ironstone, &c.

Gob-road—A road that passes through that part of the mine which has been previously worked.

Garland—A trough, or gutter, round the inside of the shaft, to catch the water running down the sides.

Holing—The lower part of the coal being taken away, 2 feet 3 inches in height, in order to bring down the overlaying mass.

Hanger-on—The man who hangs the skip on at the bottom of the shaft.

Horse-fettler—The man whose whole duty it is to provide for, and attend to, the horses underground.

Hanging—Applies to that part of the seam which remains—as when the bottom coal is taken away, the top coal is hanging.

Horns—Guides for the rope on the drum.

Hand-gears—Small winding hand-barrel, used for preliminary sinking, or to realise very shallow mines.

Holing-shovel—A short-handled, round-bladed shovel.

Hovel—An erection at surface, near the pit's mouth, for the convenience of the banksman.

Jackey-pit—A small shaft sunk inside the mine, for various purposes.

Jig-chain—A chain hooked to the back of a skip, and running round a post, to prevent its too rapid descent on an inclined plane.

Knocking-up—The banksman beating (rather peculiarly) the runner at surface, to inform the miners below that it is time to come up.

Knob—A small support for the roof.

Lazyback—The place at surface where the coals are loaded and stacked for sale.

Lid—A piece of wood placed between the top of a prop of timber, and the roof of the mine.

Level—A water passage underground.

Log, or *Baby*—A balance weight, placed near the end of the pit-rope, to prevent its running back over the pulley.

Landing—The banksman receiving the loaded skip at surface.

Ladder—Strong wood ladders, 10 to 20 feet long, to enable the collier to affix his scaffolding, when cutting the top coals in.

Lever—Strong oak levers, 15 feet long, used to lift loaded skips on the rails, in case of their getting off, or accident, &c.

Lamp—The safety-lamps of Davy, Clanney, Stephenson, Upton, and Roberts.—The majority are made by local ironmongers.

Launder—A large wrought-iron or wooden spout, into which the water-barrel is lowered, and which conveys the water to a culvert, or other outlet, near the pit's mouth.

Mobby—A leathern girdle, with small chain and hook, used by lads in drawing the ironstone from low places, on small bowkes.

Mine Surveyor—A person who dials the workings of a colliery as often as requisite, and makes plans of the mines got and ungot.

Machine—The weighing apparatus used to weigh the coals at surface.

Man-o'-War—A small pillar left in some critical situation in a side of work.

Navvy—That part of the face of an ironstone mine laying between two roads.

Net—A strong cord net, by which the large and powerful horses are let into the collieries.

Openings—Those parts of the side of the work that are between the pillars and between the pillars and ribs.

Open Work—A coal quarry.

Pricker and *Puller*—A long sharp-pointed instrument, (not unlike a boatman's shaft,) used to break out the spurns left in cutting the coals.

Pillar—A square piece of coal, 9 yards square, left to support the roof, but which in completing the side of work is often robbed—viz.: parts cut away.

Parting—A small joint in the coal measure; and when one road leads out of another, that is a parting also.

Pikeman—A man who holes or cuts the coal.

Pit-frame—The framework carrying the pit pulley.

Pit-eye-pillar—A solid piece of coal, left round the bottom of shafts, for their protection.

Ring—A circular piece of wrought iron, about 8 inches deep, used to place on the skip of coals, to increase the load.

Rise—An upthrow.

Royalty—The dues payable to the real owner of the colliery.

Rib—A barrier of coal, left between each successive side of work, to prevent either water or obnoxious vapors, arising from such old workings, spreading over the whole pit.

Runner—Landing wagon for the skip at surface.

Roofing—When the top of the loaded skip wedges against the top of the gate-road.

Rake—A strong iron rake, for loading up into iron baskets the small coals.

Runner—Applies when any part of the winding machinery breaks, and allows the loading skip, or miners, to descend the shaft with the greatest velocity.

Rate—The sides of the gate-road, or other works, falling off, and obstructing the passage.

Rodney—A roughly constructed platform, with old rails, near the pit's mouth, upon which a large fire is made during the winter nights, to light the bank.

Stint—A given quantity of work to be performed.

Side-bassett—A transverse direction, or at right angles with the line of dip.

Sleepers—Are of wood or cast and wrought-iron, according to their different purposes.

Setting—Timber setting, or props, in various lengths.

Sump—Water room at the bottom of a shaft.

Sump-planks—Strong balks of timber, bolted together, forming a temporary bottom, or scaffolding, for the shaft.

Side-laning—Making the gate-road (when abandoned for that purpose) into an opening 10 yards wide—viz.: making the gate-road part of the new side of work.

Snatch—A small chimney at surface, about 6 or 8 feet high, connected with an air-furnace and trumpetting, used to ventilate very limited underground workings, by the means of one shaft, but much disused now.

Stall—An opening made between pillars in the direction that the work is progressing and the transverse openings—also termed *openings.*

Straight stall—An excavation made into the thick coal, having the solid coal left on three sides of it.

Scaffold—Planking elevated by stays and ladders, in order to allow the miner to ascend and disengage the coal in the upper part of the seam.

Shaft—A pit from 5 to 8 feet diameter, the smaller used for ironstone and the larger for coal mines.

Shift—The extent of time taken for any particular operation.

Slipes—The sledges at the bottom of the skip, used to draw the coals upon from the work in progress to the railroad.

Smut, or *Mucks*—Bad soft coal, containing much earthy matter, found in the immediate locality of faults.

Stays—Pieces of wood used to secure the pump-trees in the engine-pit.

Stamp—A mark cut in the roof or sides of the mine, as a point of reference, to show the amount of work done.

Spurns—Small ties, or connexions, left between the coals hanging and the ribs and pillars, to ensure safety to the miner during the operation of cutting.

Sulphur—Carburetted hydrogen gas.

Stage—A particular distance that a horse travels along the gate road, and where candles are regularly placed.

Shot—Blasting.

Skip—A sledge-shaped wagon, with a wrought-iron bow, used to draw the coals up the shaft.

Straw—A fine straw filled with powder, used as a fuse.

Stone—Ironstone.

Side of Work—An excavation in the 10 yard coal, varying in extent, composed of a series of 10 yard square openings, and 9 yard square pillars, according to the nature of the overlying strata.

Spout—A channel same size as air-head, and about 4 yards long, driven from the air-head into the gate-road at about every 15 yards, so as always to keep the communication as forward as possible.

Sumping—A small square shaft, generally made in the air-headings, when crossing faults, &c., or made to prove the thickness of coal, &c.

Shet—The roof of the coal mine when broken down.

Trade—Demand for coal.

Trumpetting—A small channel cut behind the brick-work of the shaft.

Throwing—Is generally done in the night, by breaking out the small spurs left at certain distances during the cutting, and so entirely disengage the hanging coal from the ribs and pillars—having nothing left then but its own cohesion.

Tipe—To upset, to overthrow a skip.

Turn-out—A short loop line of railway, made in order to allow one skip to pass the other in the gate-road.

Tie—A support for the roof attached to the rib, forming the shape of the letter T.

Trow—A wooden spout, made in various lengths, and from 4 inches to 2 feet square, used for carrying air, &c.

Tacklers—Four pieces of chain, terminating at one end with a hook, and the other in a ring, used to tackle up the skip with, when drawing it up to the shaft.

Thurl—To make a breach into former workings or gate-roads.

Tubbing—Cast-iron cylinders, in pieces, bolted together and placed in the shaft, to enable the sinkers to penetrate quicksand, water, &c., in safety.

Ventilating-flue—Trumpetting, commonly called, but to which a new name has been recently given.

Ventilating-stack—A stack 90 feet high, with partition, and large air-furnaces, and connected with the ventilating-flue—not much used at present.

Wagon-hole—That part of the railroad ending in the side of work.

Whimsey—An engine used to draw up coals, applied more to the old atmospheric engines.

Way-end—Applied in ironstone mines to that part of the face where the road enters.

Wind-way—An air-way leading from one road to another.

Water-barrel—A large wrought-iron barrel, with a self-acting valve in the bottom, used in drawing water, where there are no pumps.

Wagon—A square platform, with four wheels placed under, for the purpose of conveying the skip of coals from the workmen to the bottom of the shaft.

CORRECTIONS TO CORNWALL MINING TERMS, page 293.

Blende—Is called *willd* (wild) lead, not *mock* lead.

Brace—Means the platform placed *over* the mouth of a shaft, or winze, and to which the tackle is fixed.

Core (pronounced *coor*)—A miner's *core* is generally *eight* hours, not *six*.

Cover—Is pronounced *coevur*.

Dredging ore—Should read *dradgy ore*, or *drady trade*—viz.: coarse poor stuff, containing but little ore.

Gossan—Is generally pronounced *gozzan*.

Lode Slovvan (a term omitted)—Means a *drang* (viz.: a drain, or open cutting) driven towards rising ground, on the indications of a lode in marshy ground.

Pot-grown—Read, *pot-growan*.

Quere—Read *queere*, or *qweear*.

Sett—The boundaries and terms of the mining ground taken by the adventurers.

Sumpmen—Not only assist the pitman, but sink the engine-shaft also.

Turning-house—The first working on the lode after it is cut in a cross-cut.

Vugh—Should be spelt *vugg*, and almost pronounced *voog*.

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